Engineering and Mining Journal

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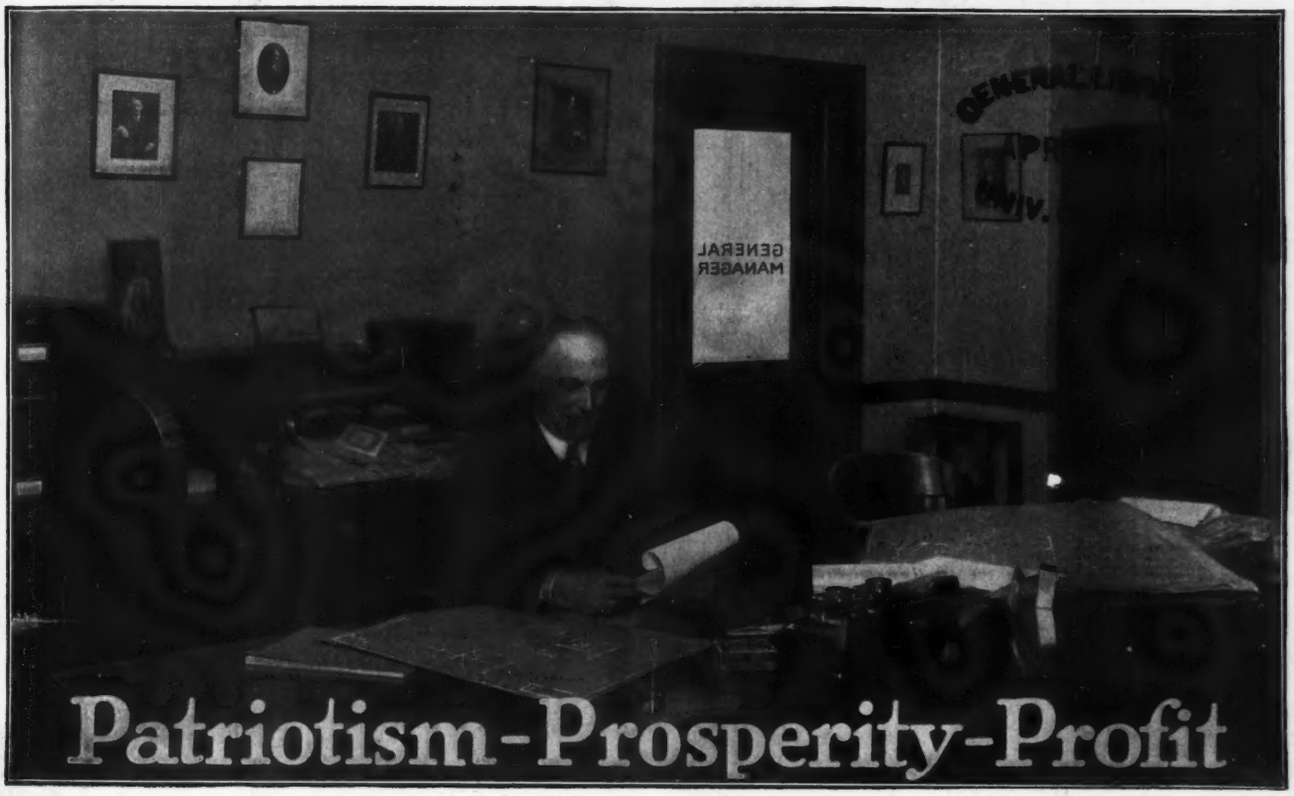

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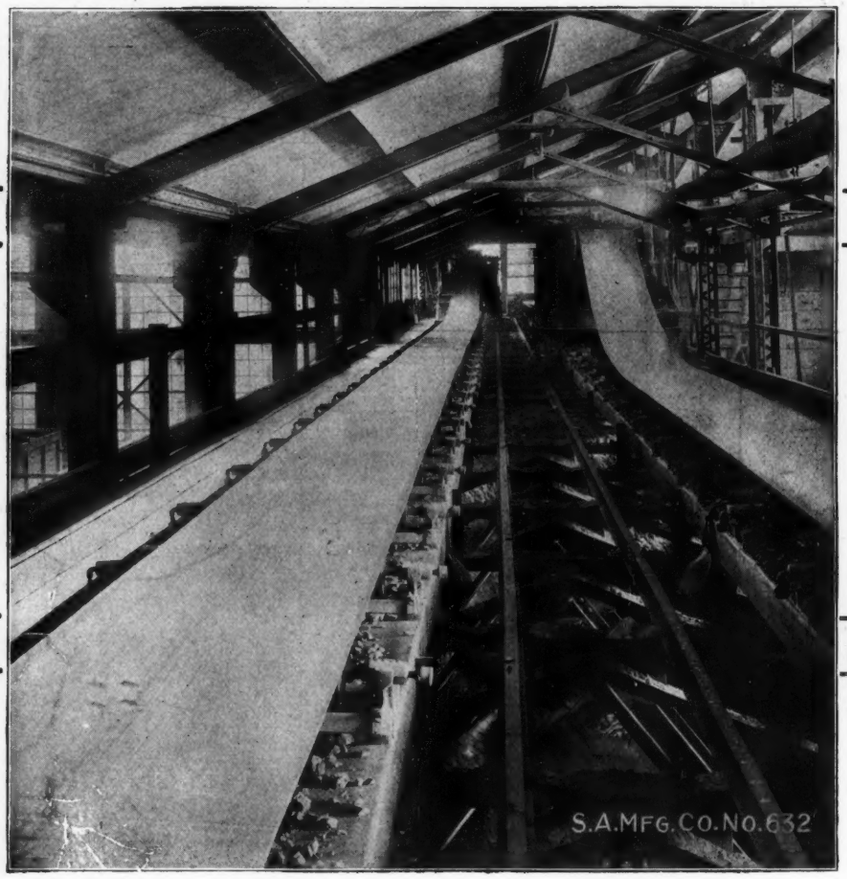

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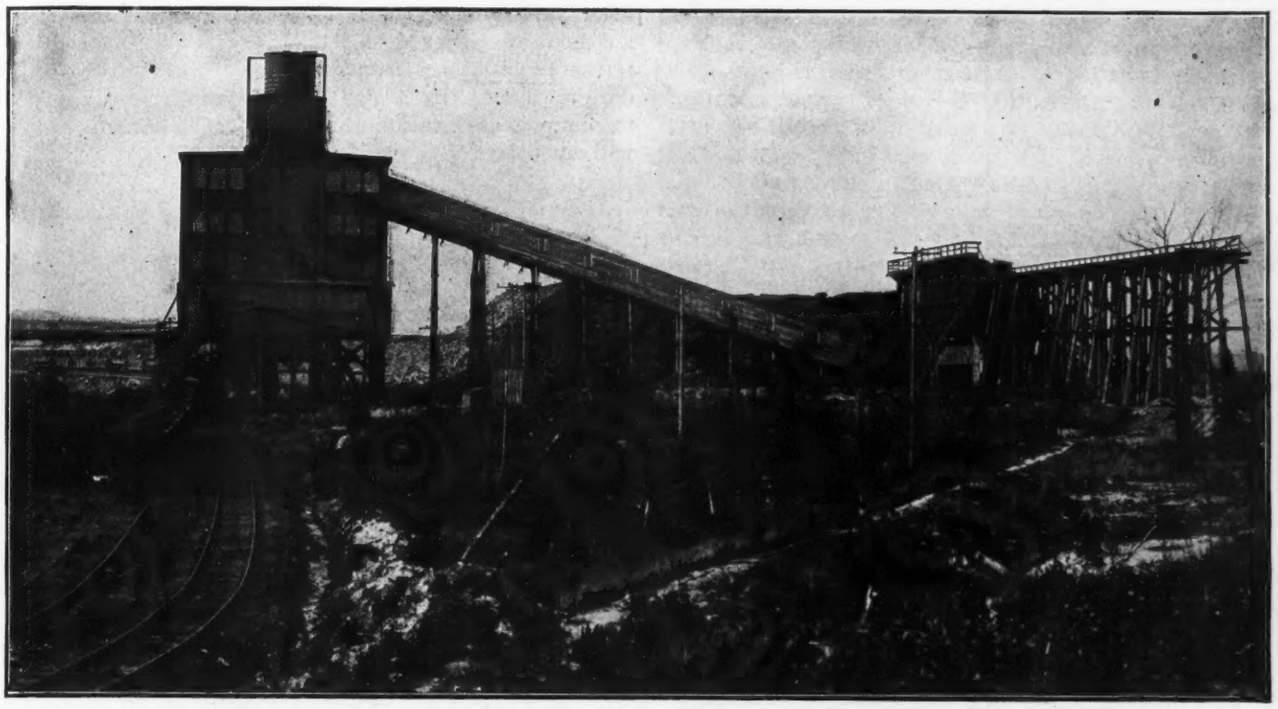

QUINN-HARRISON 7500-TON STEEL-BUILT CONCENTRATOR AT NASHWAUK, MINNESOTA

Iron-Ore Concentration on the Mesabi Range

BY F. A. KENNEDY*

The washing of iron ores in the Mesabi district of Minnesota has resulted in the recovery of a large tonnage which would otherwise have been unmerchantable, owing to its excess silica content. Modifications in machinery and methods have been introduced at some of the plants, but, for the most part, concentration is fairly simple, and consists generally of screening, log washing, and jigging. Tables and curves relating to the performances of washeries accompany the article, and several pertinent and practicable suggestions are made for the betterment of present methods.

THE wash-ore area on the Mesabi iron range covers a region of the iron-bearing formation extending from Grand Rapids on the west to the Hibbing district, about 40 miles eastward. Not all of the developed orebodies are of wash structure; some are of such grades that they can be shipped direct as merchantable ore. It is safe to say, however, that 65% of the ore is of a possible wash structure and of too high a silica content to be classified as merchantable ore. The increase in the number of washing plants completed each year on the western Mesabi shows that the product must be of a structure desirable for furnace operation. The following is a list of plants which were in operation, under construction, or with plans completed at the end of 1918:

IRON-ORE WASHING PLANTS ON MESABI RANGE

Plant	No. of Units	Plant	No. of Units
Trout Lake	6	Harrison	1
Danube	1	Mace No. 2	1
Hill Annex	2(a)	York	1
Majorca	1	Shada	1
Draper	1	La Rue	1
Patrick	1	Crosby	1

(a) Planned.

A one-unit plant contains two 25-ft. and four 18-ft. log washers, with the necessary tables for the fines. In general it may be said that 12 double-deck tables are required for each unit. The mills are all of the same general type, having in most cases been patterned after

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the Oliver Iron Mining Co.'s plant at Trout Lake. Minor changes have been made to some extent. Fig. 1 shows a flow sheet that is applicable to almost any one-unit plant now under operation. According to the flow sheet, the coarse material (taconite) is separated by use of grizzly bars, whereas at some plants it is removed by hand either before or after entering the screen; but hand-picking the taconite seems preferable where the

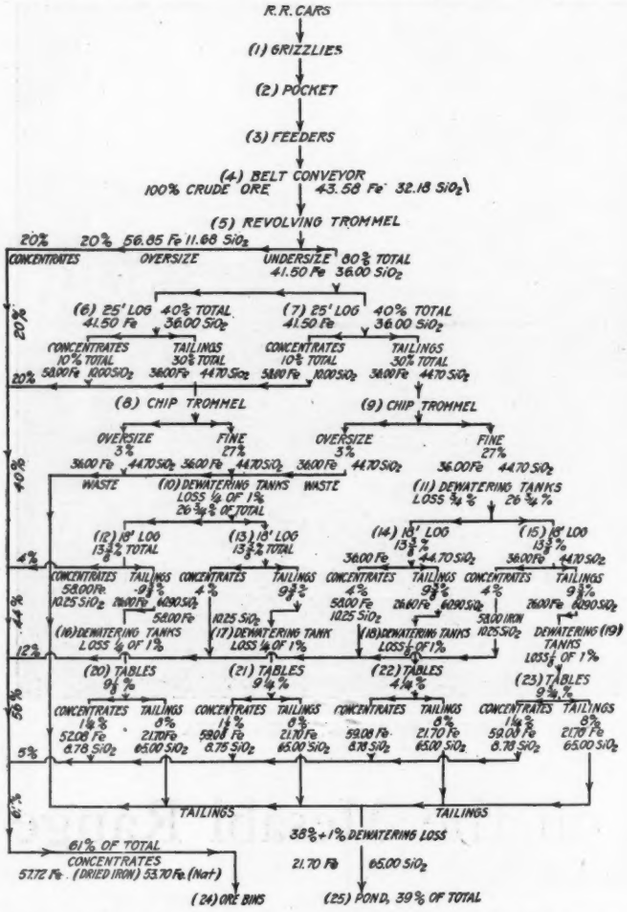

R.R. CARS
(1) GRIZZLIES
(2) POCKET
(3) FEEDERS
(4) BELT CONVEYOR
100% CRUDE ORE 43.58 Fe 32.18 SiO2
(5) REVOLVING TROMMEL
20% CONCENTRATES 20% OVERSIZE 56.85 Fe 11.68 SiO2
UNDERSIZE 80% TOTAL 41.50 Fe 36.00 SiO2
(6) 25' LOG 40% TOTAL 41.50 Fe 36.00 SiO2
(7) 25' LOG 40% TOTAL 41.50 Fe 36.00 SiO2
CONCENTRATES 10% TOTAL 58.00 Fe 10.00 SiO2
TAILINGS 30% TOTAL 36.00 Fe 44.70 SiO2
CONCENTRATES 10% TOTAL 58.00 Fe 10.00 SiO2
TAILINGS 30% TOTAL 36.00 Fe 44.70 SiO2
(8) CHIP TROMMEL
(9) CHIP TROMMEL
OVERSIZE 3% 36.00 Fe 44.70 SiO2
FINE 27% 36.00 Fe 44.70 SiO2
OVERSIZE 3% 36.00 Fe 44.70 SiO2
FINE 27% 36.00 Fe 44.70 SiO2
WASTE
(10) DEWATERING TANKS LOSS 1/2 OF 1% 26 3/4 % OF TOTAL
WASTE
(11) DEWATERING TANKS LOSS 3/4 % 26 3/4 %
(12) 18' LOG 13 3/4 % TOTAL
(13) 18' LOG 13 3/4 % TOTAL
(14) 18' LOG 13 3/4 % 36.00 Fe 44.70 SiO2
(15) 18' LOG 13 3/4 % 36.00 Fe 44.70 SiO2
CONCENTRATES 4% 58.00 Fe 10.25 SiO2
TAILINGS 9 3/4 % 36.00 Fe 44.90 SiO2
CONCENTRATES 4% 58.00 Fe 10.25 SiO2
TAILINGS 9 3/4 % 36.00 Fe 44.90 SiO2
CONCENTRATES 4% 58.00 Fe 10.25 SiO2
TAILINGS 9 3/4 % 36.00 Fe 44.90 SiO2
CONCENTRATES 4% 58.00 IRON 10.25 SiO2
TAILINGS 9 3/4 % 36.00 Fe 44.90 SiO2
(16) DEWATERING TANKS LOSS 1/2 OF 1%
(17) DEWATERING TANK LOSS 1/2 OF 1%
(18) DEWATERING TANKS LOSS 1/2 OF 1%
DEWATERING (19) TANKS LOSS 1/2 OF 1%
(20) TABLES 9 1/4 %
(21) TABLES 9 1/4 %
(22) TABLES 4 1/8 %
(23) TABLES 9 3/4 %
CONCENTRATES 1 1/8 % 52.08 Fe 6.78 SiO2
TAILINGS 8% 21.70 Fe 65.00 SiO2
CONCENTRATES 1 1/8 % 59.08 Fe 6.78 SiO2
TAILINGS 8% 21.70 Fe 65.00 SiO2
CONCENTRATES 1 1/8 % 59.08 Fe 6.78 SiO2
TAILINGS 8% 21.70 Fe 65.00 SiO2
CONCENTRATES 1 1/8 % 59.08 Fe 6.78 SiO2
TAILINGS 8% 21.70 Fe 65.00 SiO2
TAILINGS
TAILINGS
38% + 1% DEWATERING LOSS
61% OF TOTAL CONCENTRATES 57.72 Fe (DRIED IRON) 53.70 Fe (Nat)
21.70 Fe 65.00 SiO2
(24) ORE BINS
(25) POND, 39% OF TOTAL

FIG. 1. FLOW SHEET OF ONE-UNIT IRON-ORE WASHING PLANT, SHOWING APPROXIMATE PERCENTAGES AND ANALYSES

crude ore contains any large hematite boulders or a small percentage of oversize, although a careful study of the orebody will indicate which is the better method. I have seen ore taken from a large pit which, when washed, gave but one 20-yd. car of rock to 45 cars of concentrates, whereas treatment of other material from the same pit has yielded one car of rock to every car of concentrates. In the latter case it would be impossible to pick the rock out by hand and make any headway.

Standard Grizzly Bars Best Suited to Local Conditions

Most of the grizzlies now in use in Minnesota washing plants consist of inverted standard 80-lb. railroad steel, spaced 6-in. apart, but it is better to use standard extra-heavy grizzly bars with 4-in. spacing, because the former gives only 54% of the total area as screening space, resulting in a considerable quantity of fines being retained in the oversize. The grizzly bars shown in Fig. 2 (see detail), spaced at 4-in., give 71% screening area, only 29% being blanked by steel. An actual demonstration, made at the Harrison plant, where the inverted steel rails would not work, proved clearly that the use of bars was advantageous.

Fig. 2 shows a cross-section, through the receiving hoppers and grizzlies, of a six-section screening plant. Objection may be made to the hopper design, but the bars in this position and slope will work well on any ordinary wash ore, and these factors were determined after various experiences at several plants. However, a somewhat steeper slope should be given the upper bars if the crude ore contains many large flat rocks. The design was of extra heavy construction to enable a train to dump its several 35-ton cars one after another and without delay.

Change in Belt Feeder Secures Greater Output Than Formerly Achieved

The ore is fed to the belt conveyor *A* by means of a steel belt feeder, which is made with plates lapping to the front, so that any small stones or pieces of taconite that wedge in between the edges of the plates will fall out as the latter open up in going over the front roller. However, from experience in operating a number of feeders, I found that it was better to change the plates with the laps to the back. Small stones will drop in while passing over the front roller, but will also drop out on coming up over the back roller. This particular

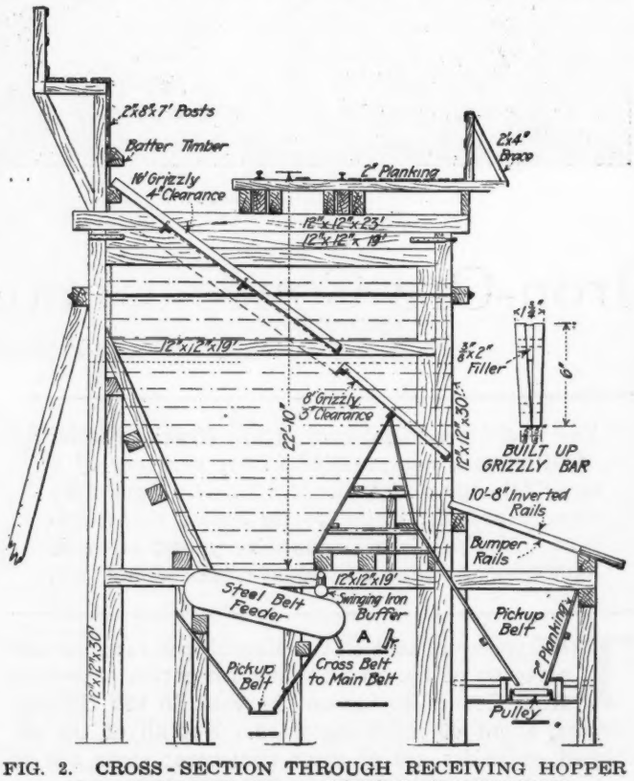
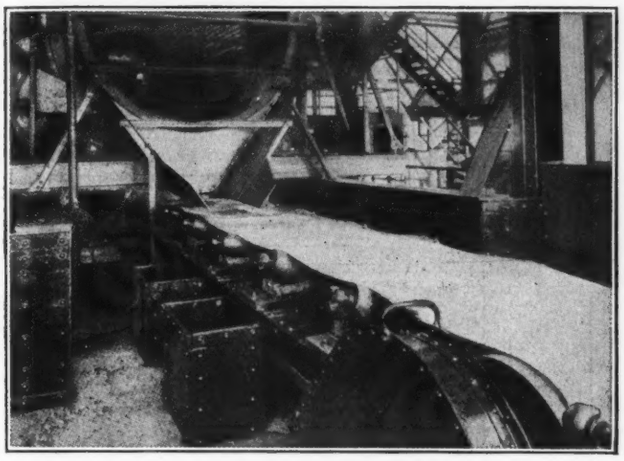


FIG. 2. CROSS-SECTION THROUGH RECEIVING HOPPER AND GRIZZLIES OF A TYPICAL SIX-SECTION SCREENING PLANT

change resulted in a larger output than it was formerly possible to achieve. This comment is not intended as a criticism of the manufacturers, but as an aid to those who have experienced trouble as a result of the breakage of plates, bolts, and binding plates, thus causing a stoppage of the entire plant. I know of two plants where the use of feeders was condemned, and where they were removed on account of the above-mentioned

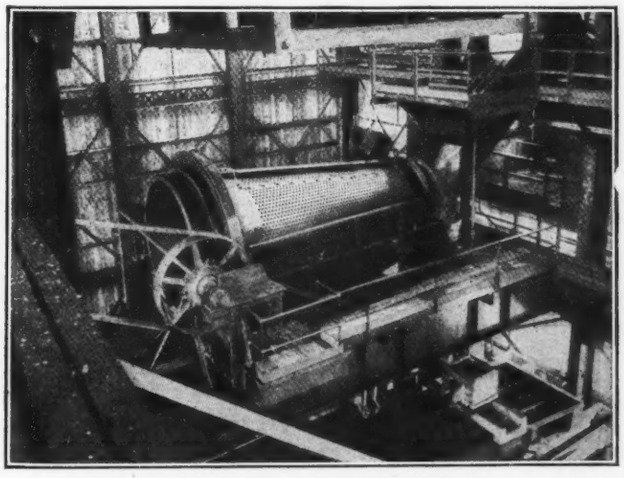
trouble, merely because the users did not know how to remedy the difficulty. Feeders are essential adjuncts in any concentrating plant and for use in connection with washing machinery. For efficient work and to secure the maximum tonnage, it is necessary to have a continuous, even feed going onto the upper screen.

In a one-unit plant the main conveyor belt that carries the ore up to the head of the belt is usually 36 in.



PICKING BELT WITH CHUTES FOR WASTE DISPOSAL AT IRON-ORE WASHERY.

wide, and should have a speed of about 240 ft. per min., on favorable ore. It is hardly possible to carry all the ore the plant can handle on a 36-in. belt with a speed of 180 ft. per min., which was the original speed adopted in a number of plants. A higher speed than 240 ft. per min. is unnecessary, and shortens the life of the belt. Examinations of several discarded belts showed that the material was only partly worn out, although in most cases it was torn or ripped by either a sharp piece of taconite or steel. Such damage can be prevented by

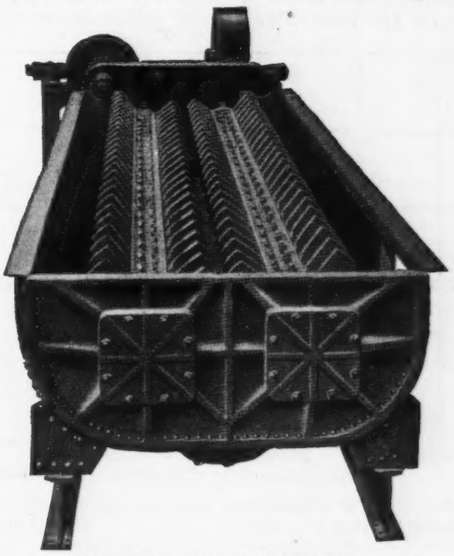


CONICAL TROMMEL SCREEN

allowing plenty of clearance along the return part of the belt and plenty of headroom underneath the lower pulley.

There is a variation in the size of openings in screens or trommels, but the average size for such work is a full punch, $\frac{3}{8}$-in. plate with $1\frac{1}{2}$-in. holes. On the average wash ore, however, this is too large an opening; and at some of the newer plants, such as the Draper and the Mace No. 2, $1\frac{1}{4}$ in. screen openings are provided. For a good grade of wash ore, it would be well to use screens with $\frac{7}{8}$-in. openings, as the former sizes put too heavy a load on the log washers, with the result that the oversize is but a small proportion of the total, whereas it should equal about 20%. By bolting a $1\frac{1}{2}$-in. screen inside of another and staggering the holes, it is possible to double the oversize without varying the grade of the concentrates, and by doing so I increased the capacity of one of the plants about 25%. A full-punched $\frac{7}{8}$-in. screen has since been purchased to replace the above-mentioned apparatus. At another plant, instead of altering the screen temporarily, the undersize from the first half of the screen went directly to the 25-ft. logs and the remaining half to the concentrate bins. This change did not make an appreciable difference in the grade, but resulted in the addition of a considerable volume of water to the concentrates. A close study of the character and structure of the ore should be made before determining the screen mesh to be used. From results obtained at several plants it appears that it is better to have the large screens driven by a gear placed parallel to the axis of the screen, than by one at right angles and on the front face.

The undersize passes directly to the 25-ft. log washers. The first half of the screen should discharge in the



AN 18-FT. LOG WASHER

center of the log and in a manner that will not wear out the shaft angles. This may be done by placing a baffle so as to produce a spray. The second half of the undersize should enter near the head of the log, as there is usually but a small amount of remaining sand to be washed out, and by this arrangement the work on the log is lightened. Both the 25-ft. and the 18-ft. logs should be provided with friction-clutch pulleys, which are essential, for if the power is suddenly cut off or the belt breaks it is a two- or three-hour job to clean out the washer before it is possible to turn the log over again. A $2\frac{1}{2}$-in. hose with a nozzle is found useful for cleaning out and can be handled best through a manhole in the bottom, near the tail end of the log.

The tailings pass into a chip screen or trommel (the oversize going to the waste pond and the undersize to the 18-ft. logs) provided for the purpose of removing chips, cinders, and all coarse particles that would otherwise plug up the spigots of the machinery subsequently

employed. It seems better practice to use a ⅜-in. wire screen instead of full-punched screens. No doubt there is a larger loss on fines with the ⅜-in. punched screen, commonly used, than in any other part of the mill, so that, if it is necessary to use punched screens of that size, a longer screen should be installed. The oversize is 50% good ore, which should be saved, for the loss probably amounts to 20 or 40 tons per day and could be recovered by putting in a two- or three-cell jig.

The undersize from the two chip screens is dewatered and the products from the spigots go directly into the four 18-ft. log washers. These operate at a lower speed than the 25-ft. log washers and require less repair work. The heads from this operation run into the concentrate bins, and the tailings, after being dewatered, are distributed over 12 double-deck tables. Single-deck tables were used at first at all the iron-ore washeries, but, later, the double-deck table was adopted as an economy.

Opinion Regarding Use of Single- and Double-Deck Tables

In iron-ore concentration, a larger load is put on a table than would ordinarily be carried if any other ore were being treated. The supporting frame and working parts of the type adopted were designed from notes taken on the concentration of minor-metal ores; and it

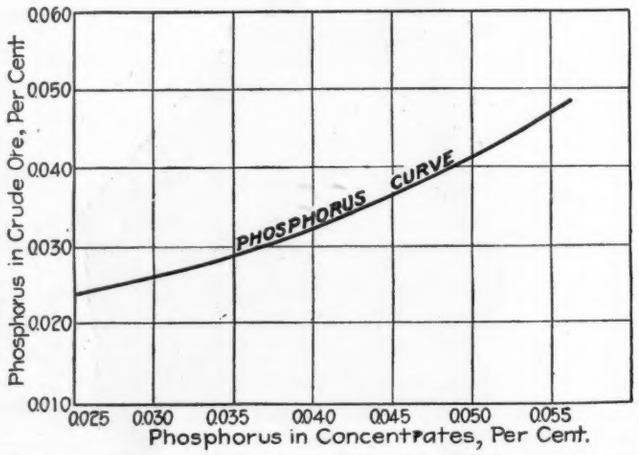


FIG. 3. CURVE SHOWING RELATIVE PERCENTAGES OF PHOSPHORUS IN CRUDE ORE AND CONCENTRATES.

was found upon adding another deck that the tables did not stand up under the increased load. I am aware that heavier parts are being placed in double-deck tables that failed owing to faulty design, but from tests and daily observation I am convinced that it is far better to use single-deck tables. From the data I am able to obtain I learn that approximately 85% of the total material that a double deck can handle can be carried easily by a single deck. Tables should be placed on a solid foundation, preferably on a ground floor, and the concentrates carried to the ore bins by means of a 7-in. x 12-in. bucket elevator.

Advantages of Classifiers in Wash Practice

The Hawkins plant, at Nashwauk, uses classifiers in the bottom of a small tank at the tail end of the 18-ft. logs. A coarse concentrate is drawn off, thereby lightening the load on the tables. This is good practice, and should be followed by other plants. In mills where the concentrates run extermely low in silica, as at the Patrick, it seems advisable to replace the tables by classifiers, but the product from the last two spigots of the classifiers should be run over tables. In this way not only as many iron units go into the concentrate as

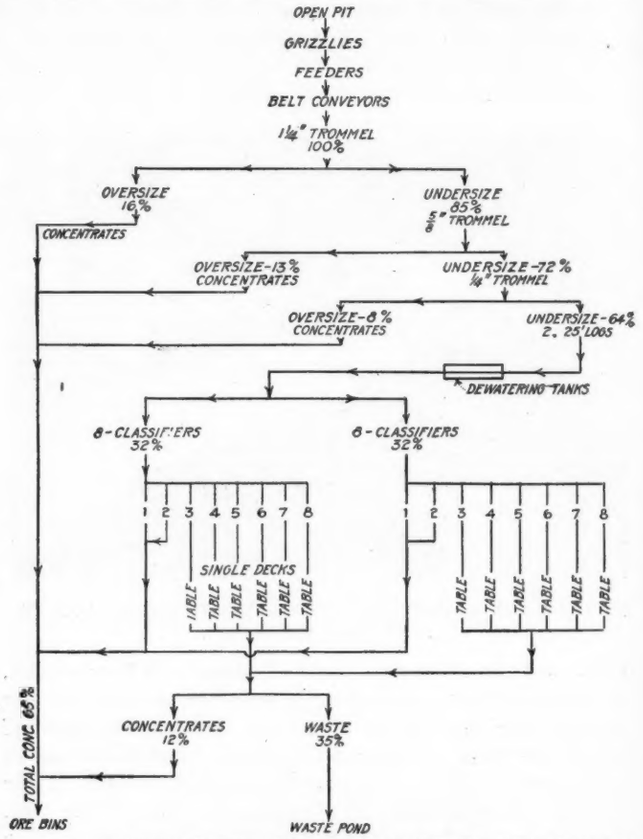


FIG. 4. FLOW SHEET FOR IRON ORES WHICH SHOW A COMMERCIAL CONCENTRATION BY A SCREEN ANALYSIS

formerly, but an additional tonnage of silica is added, which does not influence the grade to the extent of more than 2%. However, for those not familiar with the use of classifiers, I believe it best to use them in con-

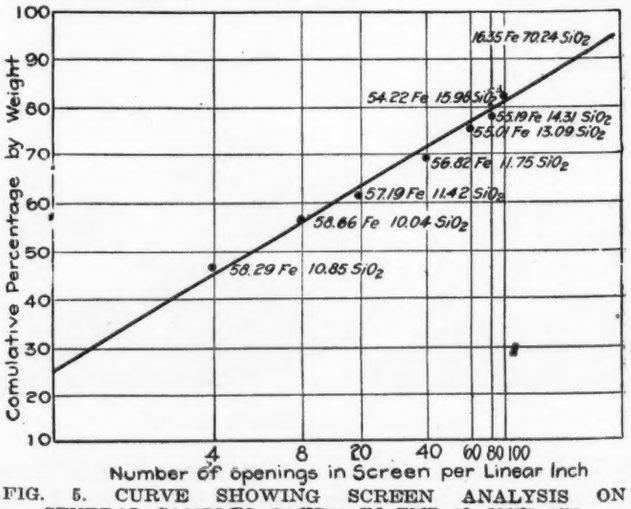


FIG. 5. CURVE SHOWING SCREEN ANALYSIS ON SEVERAL SAMPLES TAKEN IN THE NASHWAUK, MINNESOTA, DISTRICT

junction with tables. In other words, it is advisable to treat on a separate table every spigot discharge from a classifier that is not clean, as outlined on the flow sheet in Fig. 4.

The Draper mill is installing a dewatering device for all the fine concentrates. Should this prove as successful as hoped, it will no doubt be adopted by other mills, as the present method results in too much water being sent to the railroad cars. The water readily drains out, but in filling the cars a large loss of fine ore results. Some mills have installed a sloping platform underneath the loading track which has an outlet into a large elevator boot. The fine ore and water that drips from the cars is then hoisted up to a dewatering tank by means of a belt elevator, and the process not only saves the fine ore but reduces the number of men needed in front. From experience it is found best to use a fairly large pulley, 48-in. at the bottom and top; 7-in. x 12-in. buckets, spaced at 16-in., will handle the overflow from a one-unit plant.

Necessity for a Continuous and Sufficient Water Supply

The most important and essential factor for the operation of a washing plant is an ample, continuous supply of water. It is far better to be safe on the water question, in every possible manner, than to be near the limit of just having enough. In some instances pumps have been installed with ample capacity, but the discharge line was of such size that it was almost impossible to run the mill at full capacity. Automatic stopping and starting devices should be installed not only on the pump motors but on all mill motors, and they should be as nearly "fool proof" as possible. Pumping more water than needed is wasteful. A discharge pipe of ample capacity should be provided, together with a check valve and a safety valve, preferably of the spring type. If the discharge line is long, an air-inlet valve should be placed in the discharge pipe. The automatic stopping device should be so arranged that when any concentrating machine or motor stops in the mill, all the machinery controlling preliminary operations will cease automatically. Proper lines of communication by both bells and telephones should also be provided.

The figures in Table I cover a monthly report on a one-unit plant. The percentage of concentrate to crude ore washed is 67.51%, and this is somewhat higher than is usual with average wash ores of the district in which the silica in the concentrates is below 10 per cent.

Fig. 3 is a curve diagram in which the phosphorus in the crude ore is represented by the abscissa and in the concentrates by the ordinates. Knowing the phosphorus content in the crude ore, the approximate phosphorus percent in the concentrates can be determined.

Table II is a delay sheet showing the loss of time for each day as well as the total delay for the month

TABLE I. MONTHLY REPORT ON PERFORMANCE OF A ONE-UNIT WASHING PLANT

Date, July 1918	Crude Ore: Tons Washed	Fe, %	P, %	SiO_2, %	Concentrates: Tons	Fe, %	P, %	SiO_2, %	Per Cent. of Weight of Concentrate to Crude Ore Washed	Per Cent Extraction of Iron in Ore
1	5548.4	44.48	0.026	29.62	3111.0	57.39	0.038	10.42	70.46	90.10
2	3997.6	46.77	0.028	27.62	2243.0	52.24	0.036	12.03	56.11	68.67
3	4452.1	47.46	0.030	27.58	2022.0	59.51	0.037	10.35	45.42	56.94
4	...	...	...	...	...	...	...	...	...	...
5	4640.2	39.51	0.034	37.03	2866.0	57.30	0.038	11.26	61.75	89.58
6	4840.0	43.47	0.030	31.19	3288.0	57.10	0.038	11.23	67.93	89.23
7	3145.0	48.30	0.032	24.85	1678.0	58.29	0.038	8.91	53.35	64.94
8	5340.0	48.99	0.032	23.59	3983.0	59.15	0.037	9.04	74.59	90.05
9	5700.0	48.52	0.032	24.80	3581.0	59.85	0.039	8.40	62.82	77.51
10	5967.0	47.81	0.037	27.02	3480.0	61.19	0.046	7.88	58.32	74.65
11	5613.0	46.89	0.040	27.48	3041.0	60.55	0.049	8.71	54.18	69.96
12	4231.0	49.98	0.046	23.17	2660.0	60.58	0.053	8.86	62.87	76.20
13	4762.0	46.12	0.034	28.07	2633.0	57.42	0.042	12.52	55.29	68.83
14	2932.0	45.55	0.031	29.35	1540.0	58.42	0.039	10.38	52.52	67.36
15	5898.0	45.38	0.038	29.03	3212.0	58.43	0.043	10.19	54.46	70.12
16	5507.0	42.95	0.038	32.79	3402.0	56.61	0.043	12.63	61.78	81.43
17	5470.0	44.54	0.035	30.75	2982.0	57.99	0.042	11.78	54.52	70.97
18	3778.0	48.39	0.029	25.32	2133.0	59.57	0.034	9.42	56.46	69.51
19	3396.0	43.58	0.033	31.12	2403.0	58.42	0.045	10.64	70.76	94.85
20	3720.0	46.47	0.035	29.17	2416.0	57.80	0.046	10.94	64.95	80.78
21	880.0	44.48	0.026	29.62	528.0	57.39	0.038	10.42	70.46	90.92
22	2930.0	45.15	0.020	36.21	1989.0	57.24	0.036	8.92	60.11	86.09
23	4539.0	45.78	0.029	28.00	3068.0	58.08	0.037	10.23	67.59	85.75
24	5254.0	48.87	0.035	25.00	3050.0	58.55	0.041	9.21	58.05	69.56
25	7212.0	48.10	0.031	24.86	4928.0	58.74	0.038	9.50	68.33	63.44
26	7559.0	47.18	0.034	26.59	5387.0	59.98	0.041	8.46	71.27	90.60
27	6877.0	47.25	0.034	26.85	4606.0	59.77	0.042	8.84	66.98	84.73
28	2333.0	49.14	0.032	24.11	1549.0	59.23	0.042	9.52	66.40	80.03
29	4669.0	48.17	0.037	26.04	3330.0	60.41	0.046	8.56	71.32	89.45
30	5240.0	49.44	0.038	23.91	3711.0	60.78	0.044	7.72	70.82	87.06
31	3752.0	43.77	0.033	31.24	2533.0	59.01	0.041	9.54	67.51	91.02

	Tons	Per Cent. Fe Dried	Natural Fe	P	Mn	SiO_2	Al	H_2O
Crude ore washed	140,228	46.62	43.34	0.034	0.16	25.54	0.88	7.02
Concentrates recovered	88,552	58.89	54.59	0.041	0.17	9.79	0.75	7.30

Weight of concentrate to crude ore washed, 67.80%.
Extraction of iron in ore, 78.46%.

TABLE II. DELAY SHEET USED AT IRON-ORE WASHERY

Name of Plant..... Month of July, 1918.....

CAUSE OF DELAYS

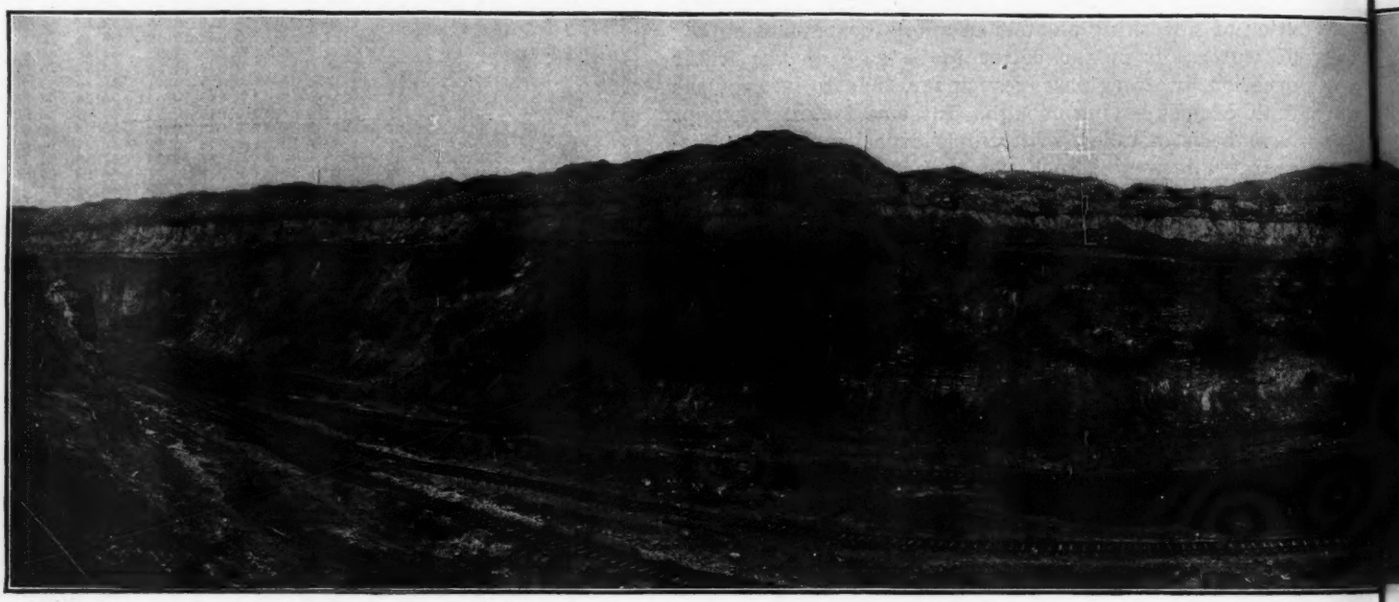
Date	Crude Ore: Day H.	Day M.	Month H.	Month M.	Season H.	Season M.	R.R. Cars: Day H.	Day M.	Month H.	Month M.	Season H.	Season M.	Plant: Day H.	Day M.	Month H.	Month M.	Season H.	Season M.	Power: Day H.	Day M.	Month H.	Month M.	Season H.	Season M.
1	..	..	..	..	..	..	5	45	5	45	...	...	5	..	5	..	100	40	..	..	..	..	..	..
2	..	30	..	30	61	45	3	55	9	40	106	30	2	50	7	50	103	30	2	..	2	..	46	05
3	3	10	3	40	64	55	..	..	..	..	..	..	..	35	8	25	104	05	..	..	..	..	..	..
4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
5	1	30	5	10	66	25	..	45	10	25	107	15	1	..	9	25	105	05	..	..	..	..	..	..
6	..	40	5	50	67	05	5	50	16	15	113	05	1	45	11	10	106	50	..	..	..	..	..	..
7	..	..	..	..	..	..	1	25	17	40	114	30	8	35	19	45	115	50	..	..	..	..	..	..
8	..	..	..	..	..	..	4	10	21	50	118	40	..	50	20	35	116	15	..	20	2	20	46	25
9	1	05	6	55	68	10	5	35	27	25	124	15	1	..	21	35	117	15	..	..	..	..	..	..
10	..	50	7	45	69	..	..	..	..	..	..	..	2	..	23	35	119	15	..	..	..	..	..	..
11	..	..	..	..	..	..	6	20	33	45	130	15	1	55	25	30	121	10	..	..	..	..	..	..
12	..	10	7	55	69	10	..	..	..	..	..	..	4	50	30	20	126	..	3	55	6	15	50	20
13	..	..	..	..	..	..	1	25	35	10	132	..	..	..	..	..	..	..	..	10	6	25	50	30
14	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
15	..	..	..	..	..	..	..	..	..	..	..	..	1	15	31	35	127	15	1	55	8	20	52	25
16	..	..	..	..	..	..	1	30	36	40	133	30	..	45	32	20	128	..	..	25	8	45	52	50
17	..	20	8	15	69	30	..	55	37	35	134	25	1	10	33	30	129	10	..	15	9	..	53	05
18	..	20	8	35	69	50	3	30	41	05	137	55	2	..	35	30	131	10	..	..	..	..	..	..
19	..	10	8	45	70	..	2	15	43	20	140	10	..	20	35	50	131	30	..	..	..	..	..	..
20	1	40	10	15	71	40	..	15	43	35	140	25	..	40	36	30	132	10	..	..	..	..	..	..
21	1	55	12	10	73	35	..	..	..	..	..	..	2	50	39	20	135	..	6	15	15	15	59	20
22	..	35	12	45	74	10	3	05	46	40	143	30	..	40	40	..	135	40	..	..	..	..	..	..
23	..	35	13	20	74	45	1	40	48	20	145	10	1	40	41	40	137	20	..	..	..	..	..	..
24	..	..	..	..	..	..	2	05	50	25	147	15	2	40	44	20	140	..	..	..	..	..	..	..
25	..	45	14	05	75	30	..	..	..	..	..	..	..	15	44	35	140	15	..	..	..	..	..	..
26	1	10	15	15	76	40	2	55	53	20	150	10	..	40	45	15	146	55	..	..	..	..	..	..
27	..	30	15	45	77	10	2	50	56	10	153	..	2	10	..	..	..	..	..	..	..	..	..	..
28	1	55	17	40	79	05	3	30	59	40	156	30	2	10	47	25	143	05	..	..	..	..	..	..
29	..	..	..	..	..	..	..	..	..	..	..	..	6	05	53	30	149	10	..	..	..	..	..	..
30	..	30	18	10	79	35	..	..	..	..	..	..	4	..	57	30	153	10	..	..	..	..	..	..
31	..	..	..	..	..	..	24	..	83	40	180	30	3	10	60	40	156	20	..	..	..	..	..	..
Total	18	10	18	10	79	35	83	40	83	40	180	40	60	40	60	40	156	20	15	15	15	15	59	20

and season. The figures on this particular sheet represent the delays during three months of operation. The power delays were higher than they should be, due to poor installations at the transformer house. Loss of time represents a big item in tonnage equivalent, and in the plant I have mentioned each 15 min. of delay represents a decrease of one car of concentrates (45 tons) in production. If the delays for the three months could have been cut down 50%, the result would have been to increase the capacity of the plant by 10 carloads, or 450 tons per day. The time lost in delays was 22% of the total operating time, of which 12% was due to the hindrances in not supplying crude ore to the plant, and to plant stoppages. The remaining 10% was caused by lack of ample supply of railroad cars and by shutdowns, resulting from electric-power troubles. The delay figures appear unusually large, yet records from another plant show 30% of the total time was consumed in delays, of which 17% was charged to crude ore and plant, and the remaining 13% to outside trouble. However, this was a new plant, which experienced considerable trouble in getting started. Another plant reports 20% delay, of which 11% was attributable to crude ore and plant, and only 9% to outside troubles.

The flow sheet reproduced in Fig. 4 is a possible treatment scheme for ores that show by a screen analysis that a commercial concentration can be made. I have not attempted to give the exact size screens that should be used, but have given the approximate size openings and the percentage of total material that each would necessarily have to handle.

The curve shown in Fig. 5 represents the average analysis of a number of samples taken from different mines, and indicates that all oversize on a 40-mesh screen will analyze approximately 56.82% dried iron, and 11.75% silica, which is a good grade of concentrate. Considering this, it would appear that a plant constructed after such a screen flow sheet would be satisfactory, but it is doubtful whether any operating company on the iron ranges would look with favor on such a radical change. In making up the flow sheet in Fig. 4, I have carried out the screen idea down to the ¼-in. size. Instead of using four 18-ft. logs, such as were used to handle the fine material passing through the chip screen, I have shown two 25-ft. logs only. In the present plants a study of the 25-ft. logs shows that they will handle from 50 to 60% of the total concentrates. This product will contain from 60 to 75% of the concentrate that screens between 20 mesh and 100 mesh. In other words, the 25-ft. logs show a good recovery on the larger percentage of the fines. For treating the remaining fines or tailings from the 25-ft. logs, which represent from 40 to 48% of the total crude ore, I have placed a series of eight classifiers following each 25-ft. log. One or two spigots could be drawn off and each following spigot treated on a separate table.

There is not much material difference in the headroom required for either plant. There is, however, a difference in the cost, and this is due largely to the fact that the flow sheet in Fig. 1 requires more machinery than the plant represented by the flow sheet in Fig. 4. The first plant has four 18-ft. logs, two chip trommels and 12 double-deck tables, and this equipment in the latter is replaced by two screens (⅝-in. and ¼-in.) one 25-ft. log, sixteen 6-in. classifiers and two single-deck tables.



GENERAL VIEW OF QUINN-HARRISON MINE, NASHWAUK, MINN., SHOWING BANKS OF WASH ORE.

For small ore deposits where the installation would not warrant a standard ½-unit plant, another ⅛-in. screen could be added below screen No. 3 in the flow sheet in Fig. 4, and this can be followed by classifiers and tables. There are a number of small wash deposits on the Mesabi range that can be treated profitably by means of such an installation.

In the matter of costs, at one plant crude ore was treated for 5¾c. per ton, the cost including operating, repairs, and office expenses, but not depreciation. Another one-unit plant, exclusive of depreciation, shows the highest cost per month for one season to be 9.41c. per ton of concentrates. In making estimates on probable costs per ton, including depreciation (which is determined by the tonnage of ore to be treated), it should not run over 15c. per ton of concentrate, or 9¾c. per ton of crude ore.

Copper-Schist Deposits of Arizona

By Theo. H. M. Crampton*

Considerable activity is to be noted in the development of certain copper-schist deposits in Arizona situated along what is known as the "schist belt." Some years ago attention was called to the porphyry-copper deposits, which were exploited and found to be far more extensive than had been thought. Today more attention is being paid to the schist deposits, and their development is opening up new and extensive reserves of copper.

The United Verde copper mine was one of the first of the schist deposits to be extensively exploited. The so-called schist belt in Arizona, as previously described, can be traced from central Arizona to the southeastern part of the state and conforms roughly to the trend of the Bradshaw Mountains. At Jerome the schist is prominent and plays an important part in the deposits of the district. Many important mines, which include the Blue Belle, Arizona-Binghamton, De Soto, Swastika and others typical of the copper-schist deposits, are situated at Mayer.

The schist in the vicinity of Mayer, and the associated copper deposits, were considered of local occurrence, but this opinion has been refuted in the last few years, as the schist belt has been proved to extend further to the southeast, and to correspond to formations at Miami and Ray, indicating that the schist of the Bradshaw Mountains may be correlated to the Pinal schist occurring at these two places.

At Cañon, a stage station at the mouth of Black Cañon, and on the main road from Mayer to Phoenix, is situated the Kay copper mine and also the Orizaba copper mine. These mines are wholly within the schist, and deposits are typical of this class. Further to the south are to be found deposits of copper in the schist, in the vicinity of Cave Creek. The Pinal schist becomes prominent a little further to the southeast and forms an important part of the deposits around Miami and Ray.

The Pinal schist is practically continuous between Ray and Miami. The Gibson mine is within the schist belt to the south of Miami, and the Cole-Goodwin mine, about half way between Ray and Miami, is typical of the copper-schist deposits. Most of the copper mines convenient to transportation have received attention during the period of high prices of copper which recently prevailed. These mines have produced to such an extent that their reserves have been affected, and it is not surprising to note the development of deposits which in the past have not had the advantage of cheap transportation. The Orizaba and the Kay mines, at Cañon, have reached such a state of development that it is possible that a railroad may be built into the district. The same can be said of the country to the south of Miami and to the east of Ray, where the development of the Cole-Goodwin mine has attracted attention.

On the surface the copper-schist deposits in Arizona are leached, due to the porous nature of the formation in which they occur. The surface indications are in many cases far from attractive. The leaching action at many of the properties has been extensive, and considerable depth had to be attained before the secondary enrichments were encountered or the primary ores were found in place. The depth to which the leached zone reaches has retarded this class of deposit, but depth has proved that the copper deposits within the belt are generally of sufficient extent to warrant extensive exploitation. The copper-schist deposits are invariably accompanied by diabase intrusions, and occur along major fault and shear zones. The strike of the faults does not usually conform to the direction of schistosity.

The characteristic ores of the Arizona copper-schist belt are sulphides, with a gangue of quartz, calcite, and sericitic schist, which combination makes them suitable to gravity concentration, or to concentration by flotation. They do not show to any great extent the carbonates which appear in the porphyry-copper deposits. The metallurgical difficulties met in the treatment of the porphyry-copper ores are not encountered in the treatment of the copper-schist ores.

THE LIGHT AND DARK LAYERS SHOW, RESPECTIVELY, THE SAND AND HIGH-GRADE ORE STRATA

*Mining engineer, 1501 West Monroe St., Phoenix, Arizona.

Heavy Drilling at Sacramento Hill*

BY ROBERT T. BANKS†

The operation of stripping the overburden from Sacramento Hill is a difficult undertaking, inasmuch as it requires the removal of solid rock capping. The method adopted provides for a series of benches, which are operated simultaneously, steam shovels being used to load the rock into cars after it has been drilled and blasted. In drilling the overburden, churn-drill holes are first put down from the various benches and blasted. Supplementary work, consisting of flat holes drilled by means of piston drills and blasted, serves to reduce the rock to such size that it may be handled by steam shovels.

SYSTEMATIC prospect drilling on Sacramento Hill, at Bisbee, Ariz., by the Copper Queen branch of the Phelps Dodge Corporation has developed orebodies estimated to contain about 15,000,000 tons of copper ore averaging more than 1½% copper. The ore occurs in two bodies, known as the east and the west, which are separated by a comparatively barren strip of ground from 400 to 500 ft. wide. The west orebody, which is to be mined first, is accurately defined, and it is estimated that subsequent mining will produce over 6,000,000 tons of ore. Drilling is still in progress on the east orebody, but sufficient exploration has been done to assure a mine production of over 10,000,000 tons of ore. The west orebody averages over 2% in copper content; that of the east body is lower.

Sacramento Hill, the most prominent physical and geological feature of the Warren district, is a massive granite porphyry stock. Around its southern base, in a semicircle, are grouped the mines of the Copper Queen and the Calumet and Arizona companies. The hill itself, with reference to the newly developed orebodies, is a capping of overburden or waste, and a large part of the hill must be removed before mining operations can begin. The stripping operations on the west orebody will include the removal of approximately 15,000,000 tons of waste, and the completion of this work will require about two years, so that the undertaking is necessarily an expensive one. Every ton of waste is solid rock, which must be drilled and blasted before it can be handled by the steam shovels.

BENCH METHOD OF EXCAVATION

To carry on stripping operations, the hill has been laid off in a series of benches. The lower or machine-shop bench is immediately over the orebody, and three benches above this are 60 ft. apart vertically. Each bench is provided with its own steam shovel and trackage system, and the broken waste is placed on 20-ton side-dump, standard-gage cars. Because of the heavy grades required to reach the dumping ground, four cars constitute a train, which is drawn by an oil-burning locomotive.

A BLAST ON SACRAMENTO HILL, BISBEE, ARIZONA
Firing four churn-drill holes and 12 toe holes by electricity

Both churn drills and tripod drills are used in the rock-breaking operations. From the bench above, 60-ft. churn-drill holes are put down. These are first "sprung," then loaded and fired by electricity. To relieve the churn-drill holes, 22-ft. flat holes are drilled at the base of the bench by means of tripod drills. These also are

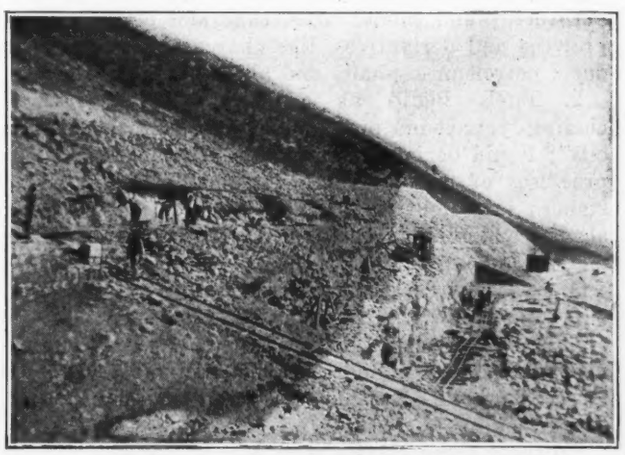
*From *Mine and Quarry* for March, 1919.
†Mining engineer, Mills Bldg., El Paso, Texas.

"sprung" first and then each hole is loaded with two to three boxes of dynamite. Because of extremely variable rock conditions, no set rule can be applied to the spacing of churn-drill holes. It is simply a case of "the harder the ground, the closer the holes and the heavier the charge."

Piston Drills Used in Drilling Toe Holes

After experimenting with several types of drills on the "toe-hole" work, including heavy piston machines and the hammer type with independent rotation, the Sullivan "Hyspeed" piston drill with 3¼-in. cylinder diameter was selected, and is now used exclusively for this work. These drills have seen extremely hard service, and their operation has been most satisfactory and efficient.

The air for the piston drills is supplied from the Copper Queen power plant. Each machine's crew consists of a Mexican runner and helper. Toe holes are spaced approximately 6 ft. apart when drilled in hard ground and from 8 to 15 ft. apart in the medium



EXCAVATING FOR CONCENTRATOR NEAR SACRAMENTO HILL

and broken ground. All holes are drilled nearly flat, with just enough down pitch to permit water to run into the hole. Solid steel with a crossbit is used, and blow pipes are employed to help clean the holes.

Rock Structure Makes Drilling Difficult

In many places extremely difficult drilling ground has been encountered, the rock being unusually hard and at the same time "fitchery" and "cavey." Consequently, many holes, after reaching a depth of 15 ft. or more, caved behind the bit, making recovery of the latter difficult. The extremely variable ground has made the keeping of accurate drilling records impracticable, but in hard ground one 22-ft. hole is considered a shift's work for a runner and helper. When drilling conditions are reasonably good a crew will drill two of the 22-ft. holes in a shift. All machines are mounted on heavy tripods, and as the ground is usually rough and covered with boulders, considerable time is consumed in setting up and moving.

New Millsite Being Cleared

Coincident with the stripping operations on Sacramento Hill, the Copper Queen company is preparing a millsite for the erection of a 4000-ton concentrator, the work being so planned that the concentrator will be finished about the time the stripping operations over the west orebody are completed. A small test mill has been in operation for some time, and satisfactory results have been obtained by the use of the latest practices in gravity concentration and flotation.

A millsite has been selected on the southern slope of the Mule Mountains, facing the international border, about two miles south of the Sacramento Hill operations and ½ mile southwest of Warren. Ample tailings storage is provided for on the sloping mesa to the south. In preparing the terraces for the mill floors, extremely hard, close-grained quartzite and limestone were encountered almost at the surface. Sullivan "DP-33" hollow-piston rotators were selected for drilling operations in this connection, the air being supplied through a 5-in. air line from the Copper Queen power plant. Sixteen of the Sullivan rotators have been in constant use since this work started. Hollow hexagon rotator steel, with a crossbit, is used, and holes are drilled from 4 to 6 ft. deep. The drill steel is sharpened at the Copper Queen central shop.

The management has been exceptionally careful in considering the safety of the workmen at the millsite. In blasting, it has been found good practice to fire from 200 to 300 holes at a time, giving the workmen ample opportunity to get out of range of flying rock. It is worthy of note that only one man has been injured on the works, and this injury consisted of a slight scalp cut. This is probably a record, inasmuch as the work on the millsite has been in progress more than six months and no fewer than 125 men are employed.

Stripping operations on Sacramento Hill and the work on the concentrator are in capable hands, as is customary in the Phelps Dodge organization. To these officials acknowledgment is tendered for their courtesy and assistance in securing the photographs and the above information.

A New Composite Fuel

The executive committee of the Submarine Defence Association has authorized the release of a statement concerning the new fuel developed under its auspices since the United States entered the war. The assistance of the U. S. Navy Department was extended, and constant facilities were thus provided for working tests of the fuel at sea.

In 1917 and 1918 the situation in England, France, and Italy was so serious as to threaten a possible paralysis of naval movements. The emergency mobility of the Grand Fleet that stood watch and ward through nearly four and a half years of sea guardianship depended on oil fuel, yet the liquid fuel supply was put in constant jeopardy by submarines. In 1918 the British Admiralty widely advertised a reward for a means of mixing oil and coal tar for naval fuel use. Out of persistent peril and menace grew the renewed search for a mixed fuel in the United States. With the assurance that ample liquid fuel reserves could be made available within the borders of England, would come the certainty that no submarine successes could be won which would keep the Allied fleets from the exercise of the sea power which would make victory on land ultimately certain. Lindon W. Bates has had the personal direction of the development of an oil-and-coal composite which has now been fully tested and its value demonstrated. The problem, it is maintained, has been solved.

In making an oil-and-coal composite an insuperable

difficulty heretofore has been the persistent settling out or sedimentation of the heavy coal and tar particles. This destroyed the value and utility of all mechanical mixtures. Today it is possible to suspend for months in oil 30% to 40% of coal, pulverized so that about 95% passes through a 200-mesh screen, assisting the suspension with a special fixateur. It is now possible to combine in a stable liquid fuel about 45% oil, 20% tar and 35% pulverized coal, thereby replacing over one-half of the oil, securing equal or greater heat values per barrel and saving considerable cost.

Pulverized coal burned alone cannot in many cases replace oil. Especially is this true on shipboard. Radical changes in oil-burning installations become necessary, and its storage requires too much space and thus limits the cruising radius of war vessels. The new fuel has received thorough investigation on land and sea. The vessel assigned by the U. S. Navy Department for experimental and demonstration purposes was equipped with Normand boilers. With practically no changes in the oil-burning equipment, the new composite fuel has been burned and stored for months on this ship. Trials in Long Island Sound have been made, and for land use a fuel plant has been installed at one of the large refineries, and results confirm all claims.

Pulverized coal can now be successfully held in suspension so that the liquid flows freely through the pipes, preheaters, and burners of ships, and power, heating, and industrial plants equipped to burn fuel oil. Months after mixing, the composites show little or no deposit. A fixateur, which comprises about 1%, or 20 lb., per ton, acts to stabilize the particles of pulverized coal dispersed in the oil. The fixateur and fixated oil are readily made and may be shipped anywhere. The manufacture or distribution of the new fuels incorporating solid carbons in fixated oils involves no doubtful process or industrial problem. On burning, the combustion is so complete that with fair coal there is left no slag and little ash, what there is being light as pumice and granular as sand.

Each locality may have its special composite containing the cheapest available coal, oil, and other ingredients. Each duty will be best accomplished by a brand to some determined specification. Ships may thus obtain the cheapest liquid fuel in any port. Land plants and railroads may buy from refineries any grade of the new fuel they desire to the prescription wanted, or they may obtain the appropriate fixated oil and make the final composite themselves as and when required. No change in the oil-storage or oil-burning equipment is necessary.

A demonstration test unit, to manufacture and use the new fuel on land, is installed in Brooklyn. The fuel made is burned for power purposes in the works. In addition to those taken on the naval vessel, precise evaporative and efficiency tests have been made according to the rules prescribed by the Codes of 1915 issued by the American Society of Mechanical Engineers. It is now to be tested at several steel-making plants.

Fuel made with pressure-still residuals—oil, wax tailings, crude-oil coke—is another gratifying success. These residuals are the cinderella products of refining. Liquid fuel so made may add many millions of barrels in this country to each year's stock of available fuel oil without increase of oil-well production or strain on rail or sea transport. From these residuals, a fuel is prepared so low in sulphur that it will command a premium because valuable in making higher-grade alloy-steel.

As world wants exist and grow, a serious scarcity of oil may develop. There are five things only that may be done to meet this:

1. Increase the production of oil.
2. Save waste.
3. Diminish use.
4. Conserve the oil supply by incorporating coal to make the new fuel.
5. Augment the supply of fluid fuel by finding new sources in tar and pressure-still oil and fluidized coal.

These last two means are accomplished by the new fuel. Shortages may be obviated thereby, not alone without industrial hardships, but in most cases with less cost, and the steel products will have higher tensile strength and better qualities.

Heretofore dependence has been placed exclusively on three classes of fuel:

1. Fuels solid at ordinary temperatures, including coal and derivatives—brown, lignite, bituminous, anthracite, and cannel coals, coke and pitch, vegetable growths and derivatives, like charcoal, pitch, and sawdust; petroleum-asphalts and allied solid substances.
2. Fuels liquid at ordinary temperatures, including petroleum and derivatives, principally "fuel oils"; liquid derivatives of the distillations by various processes of coal and woods, asphalts and allied substances into light oils, middle fraction oils and tars; alcohol and similar substances; vegetable oils, animal oils, and molasses.
3. Gaseous fuels, either artificial or natural.

Of the liquid class practically only "fuel oils," tars, and alcohol are used for heat and power production—alcohols and animal and vegetable oils only for small domestic purposes—and molasses as an emergency fuel in sugar making.

To these three classes may now be added a fourth—the composite fuel, uniting the solid and the liquid and consisting of synthetic fuels in three sub-classes—liquid composite fuels; mobile composite fuels; and solid composite fuels.

To produce the new fuels it is necessary to adopt certain processes modified to suit the blend or grade desired; and certain fixateurs, primarily to stabilize synthetic fuels the separate elements of which are of different specific gravities and characters, so that the finished products have each a homogeneous and definite nature.

Rgarding the nature of the fixateurs and special incorporation and treatment process, it will suffice to say that the fixateurs and treatments produce a state in which the settling force of gravity is overcome. Certain substances are also incorporated during the main process or when forming the fixateur, which is itself incorporated. Some of these may remain in the composite fuel product in whole or part, or, having performed their duty, may be distilled and recovered, and so used again and again.

An Improvement in the Method of Manufacturing Cyanide has been patented in England. Iron carbonyl is used as a means of effectively producing and distributing the iron catalyst in the reaction mass, in the case where cyanide is manufactured by the reaction of an alkali metal or salt, carbon and introgen. One application of the invention involves the introduction of the iron carbonyl as a vapor.

Army Gas Masks in Sulphur-Dioxide Atmospheres*

By A. C. FIELDNER and S. H. KATZ

The use of toxic gases in warfare has led to the development of a new type of mask, which promises to fill a long-felt want in the chemical and metallurgical industries. Heretofore, workmen around plants using processes in which acid fumes are given off made shift to protect themselves, in a more or less inadequate manner, by wearing moistened handkerchiefs, or respirators containing wet sponges, over the mouth and nose. The close of the war now makes available the Army-type gas mask, which is admirably adapted to filtering out many chemical fumes and acid vapors from inspired air, provided the concentration of gas is less than 1 or 2 per cent.

THE possibility of using Army masks around smelteries and sulphide roasters for protecting the workmen from sulphur-dioxide fumes was suggested, almost a year ago, by George S. Rice, of the Bureau of Mines, and at his request several patterns of Army masks were tested in various concentrations of sulphur dioxide to determine the degree of protection afforded.

Sulphur dioxide is an irritating, irrespirable gas, relatively non-toxic as compared to carbon monoxide or oxides of nitrogen. There is little danger from sulphur-dioxide poisoning, because the fumes are so irritating that the victim is compelled to seek air at once. In extreme cases[1] of high concentrations, when the victim cannot retire from the fumes, death may result from respiratory spasms and asphyxia. Ordinarily, however, workmen exposed for some time to a mild degree of sulphur-dioxide poisoning complain of headache, anorexia, spasmodic cough, sneezing, hernoptysis, bronchitis, constriction of chest, gastro-intestinal disorders, conjunctivitis, smarting of eyes, lachrymation, and anemia. For these symptoms workmen soon acquire toleration. The inhalation of large quantities of sulphur dioxide produces ulceration of the mucous membrane.

The Selby Smelter Commission[2] made a thorough investigation of the effect of various concentrations of sulphur dioxide on the senses of a number of persons. The average results of these tests were:

Physiological Effect of Various Concentrations of Sulphur Dioxide

Three to five parts per million (by volume): Plainly or faintly detectable by smell or taste.

Eight to twelve parts per million (by volume): Slight throat irritation and tendency to cough.

Twenty parts per million (by volume): Very distinct throat irritation, coughing, constriction of chest, lacrymation, and smarting of eyes.

Fifty parts per million (by volume): More pronounced irritation of eyes, throat and chest, but possible to breathe several minutes.

One hundred and fifty parts per million (by volume): Extremely disagreeable, but could be endured for several minutes.

Five hundred parts per million (by volume): So acutely pungent as to cause a sensation of suffocation, even with the first breath.

With no concentrations of less than 50 parts per million was there produced any feeling of nausea, and the tendency to nausea with the highest concentrations was only slight. Experiments made independently disclosed substantially the same results and indicated that 370 parts per million (0.037%) could be endured for only one-half minute.

Mouthpiece Type U. S. Army Mask

The standard U. S. Army gas mask of the mouthpiece type is shown herewith. It consists essentially of a facepiece of rubberized fabric, impermeable to gas, connected by a short length of flexible rubberized tubing to a canister containing the absorbents. The wearer breathes through a rubber mouthpiece, the nose being closed by a spring clip, mounted on the inside of the mask. Leakage through the facepiece will affect only the eyes of the wearer, as the gas cannot enter the lungs. The inhaled air enters the bottom of the canister through a disk valve that closes on exhalation; the expired air passes out through a rubber flutter valve, projecting downward from the metal elbow tube just outside the facepiece.

FIG. 1. U. S. ARMY GAS MASK, MOUTHPIECE TYPE

FIG. 3. TISSOT-TYPE GAS MASK

The Type "F" standard Army canister, shown in section in Fig. 2, is 5½ in. high and contains 42 cu.in. of a mixture of coconut charcoal and "purple" soda lime, and two cotton wadding filter pads, placed at one-third and two-thirds distance from the bottom, respectively. One of us, wearing this outfit, entered the gas chamber containing a concentration of 0.46% sulphur

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[1]Thompson D. Gilman, M. D., "The Occupational Diseases." D. Appleton & Co., New York, 1914, p. 360.

[2]Holmes, J. A., Franklin, E. C., and Gold, R. A., Report of the Selby Smelter Commission, Bureau of Mines, *Bull.* 98, pp. 172-175.

and remained one hour, without detecting any gas whatever, except on one occasion, when the mask was disarranged, and then sulphur dioxide penetrated to and irritated the eyes. On adjusting the mask and clearing the facepiece, the gas disappeared, and no discomfort whatever was experienced thereafter from that source. During a part of the time, work was done on a bicycle dynamotor.

More sulphur was then burned, until a fog was produced in which objects could not be distinguished at distances beyond 4 ft. Analyses showed that the concentration was 1.17% sulphur dioxide. No discomfort of any kind could be felt by the wearer, other than that due to the mask itself.

Life of Canisters in High Concentrations

Tests were made to determine the life of the standard Type "F" Army canister in an atmosphere containing 5% sulphur dioxide. The gas was put up in the chamber from a cylinder of liquid sulphur dioxide, attached to the chamber. Analyses of the chamber gas were made by drawing two liters of gas through a standard iodine solution and titrating back with standard sodium-thiosulphate solution. Twenty canisters were tested, in lots of 10 each. The men did not enter the chamber, but were seated on the outside, wearing the facepieces, which were connected to iron pipes that passed through the walls of the chamber. The canisters were attached to the other end of these pipes on the inside of the chamber. As soon as a man detected gas coming through his canister, as shown by throat irritation, the time was taken, and the canister was considered exhausted.

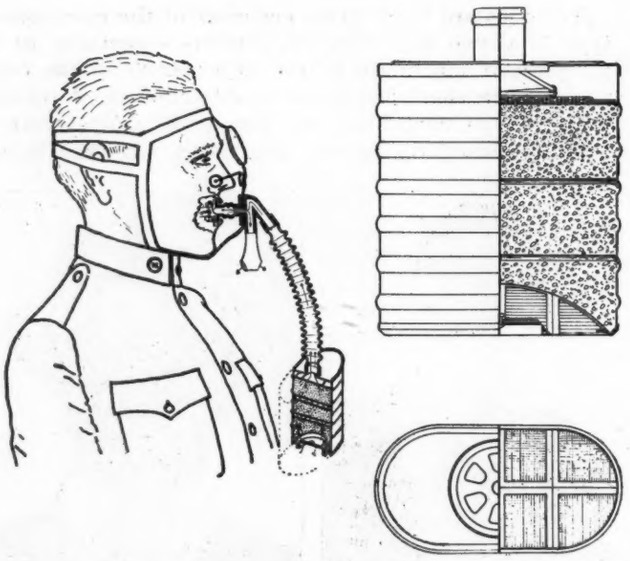


FIG. 2. SECTIONAL DIAGRAMS OF U. S. ARMY GAS MASK AND CANISTER

Tested under these conditions, the 20 canisters served to remove all sulphur dioxide for periods of time varying from 18 to 41 minutes. The average service time was 29 minutes. The large variation in service time for the individual canisters was due, in part, to differences in the canister fillings, but mostly to differences in the breathing rates of the men. Individuals breathe different amounts of air. A small man may breathe only 5 liters per min. when at rest, while a large individual may require 10 or 12 liters. The average rate of a number of men, when at rest, is approximately 8 liters per min. Moderate exercise increases the rate to approximately 30, and vigorous exercise causes a breathing rate of 60 to 70 liters. Hence, the efficient life of a gas mask canister is proportionately less when the wearer is engaged on continuous work.

In making these tests with high percentages (5.07%) of sulphur dioxide, the canisters became warm after 15 minutes' use. A temperature of 80° C. was noted in some of the canisters. This elevated temperature made breathing rather uncomfortable toward the end of the test; however, all the men were able to continue breathing through the canisters until the gas finally penetrated the absorbent.

Practical Tests by Anaconda Copper Mining Company

Several Army masks of the mouthpiece type fitted with standard Type "F" canisters, containing soda lime and charcoal mixture with two cotton wadding filter pads, were tested under practical conditions by James Kane Murphy, assistant superintendent of the Washoe reduction works of the Anaconda Copper Mining Co., at Anaconda, Mont. The following paragraphs are quoted from his report:

> On Oct. 23, 24 and 25, we had considerable repair work to do on one of our Cottrell treaters. This treater takes one-quarter of the gas from Roaster No. 2. During the repair work, it was shut off as tight as possible, but there was such a leakage of SO_2 gas that it was impossible for a man to enter the treater to do any work. The iron workers repairing this treater were able, two at a time, to put on these masks, and do their repair work in the treater. The men stayed in about 20 min. at one time; by that time, the heat and dust caused them to come out, but the masks were very satisfactory and work could be done with them by proceeding slowly.
>
> One test on these masks was performed in the No. 2 roaster ventilating tunnels when flotation calcine was drawn into cars ahead of the man with the gas mask on. It is absolutely impossible for a man without a mask to even attempt to stay in this place. Most of the dust coming from the cars, which were being loaded ahead of the man with the gas mask, will pass through 200 mesh, but none of the men wearing a mask in this place had any trouble with dust.
>
> A third mask was tested in a high concentration of gas. The mask was carefully adjusted about the face, and the person making the test was in an atmosphere containing about 5% SO_2. E. A. Bernard, superintendent of calcining, personally put the mask on in this atmosphere, beside two other men. All decided that the gas came through the canister. This test was made on gas from the top hearth of an Anaconda-type roaster furnace. The hearths on this furnace are similar to a Wedge roasting furnace. A steady wind was blowing against the east side of the furnace, so all doors on the top floor were opened, thus forcing a considerable proportion of the furnace gases out of the west doors. The testers stood as close as possible to the doors through which the gas came. This gas contains some SO_3, much moisture, dust, and some As_2O_3, besides the SO_2.

This indicates that the simple Army gas mask is exceedingly valuable around sulphide roasters, and, in fact, in any operation in which sulphur dioxide is given off. The third test in which gas penetrated the canister illustrates the limitation of this type of protective appliance. It must not be used in too high a concentration of gas. In this case, the percentage of SO_2 was probably higher than 5%, as tests at the American University Experiment Station of the Chemical Warfare Service have shown that the standard Army canister will remove 5% of sulphur dioxide for at least fifteen minutes.

Special Canister Filling for Sulphur Dioxide

The standard Army canister contains 40% soda lime and 60% charcoal. The charcoal is of less value in absorbing sulphur dioxide than soda lime. Hence, for use in sulphur dioxide and dust an all soda-lime canister with cotton-wadding filter pads will last from 50 to 100% longer than the standard canisters used in the Anaconda tests. This is shown in the comparative canister tests with different fillings against 0.5 per cent.

The life or service time of the canister is the time

in minutes during which all traces of SO_2 are absorbed by the canister. The breakdown of the canister is shown by the change in color of a sensitive potassium iodide-starch solution through which the effluent air from the canister is bubbling during the test.

The standard Army canister described in the foregoing tests contains 42 cu.in. of absorbent, weighs 1⅜ lb. and has a resistance to flow of 3½ to 4 in. water column at 85 liters per min. flow. This high resistance obliges men to work rather slowly while wearing the mask. A second disadvantage to which Mr. Murphy has called special attention is the short service time of the absorbent. Both of these defects can easily be remedied by increasing the cross-sectional area of the canister without at the same time increasing the height in proportion.

Recommended Type Includes Tissot Gas Mask and Large Canister

Although the mouthpiece type of mask was found fairly satisfactory in practical use, it is believed that the later type of Tissot mask, Fig. 3, in combination with a 100 cu.in. soda-lime canister, will prove the best outfit for exclusive use in sulphur-dioxide and acid gases. The elimination of mouthpiece and nose clip increases the comfort materially, and enables the wearer to keep it on for hours at a time. The large eyepieces, held rigidly in proper position by the well-fitting substantial facepiece, afford a large angle of vision, thereby greatly increasing the efficiency of the workman wearing the mask. He should be able to do substantially the same amount of work as without the mask in a normal atmosphere.

Aside from the many metallurgical operations in which sulphur dioxide is given off, a respirator or gas mask designed for this purpose should be useful in sulphite-pulp and paper mills, in sulphuric-acid plants, and, in fact, for protection against any acid gas such as chlorine, phosgene, carbon dioxide, hydrocyanic acid, oxides of nitrogen and hydrochloric acid.

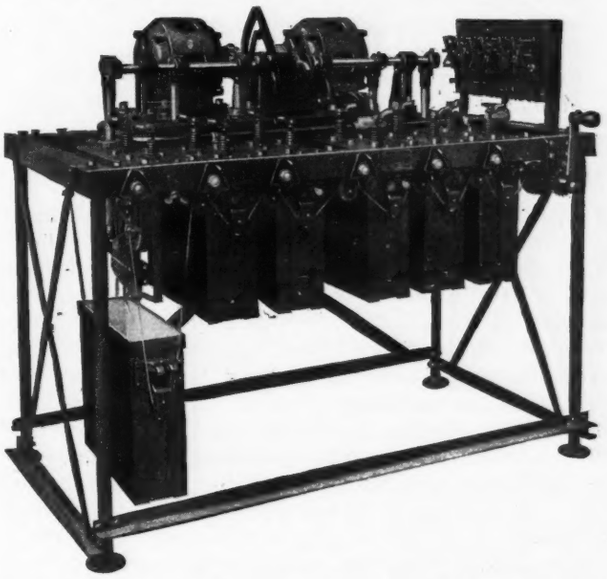
Gas Masks Limited to Low Concentrations and Situations Where Oxygen Content Is High

In closing this paper, we feel it necessary to issue an emphatic warning against the indiscriminate use of gas masks for any and all purposes. The soldiers in the Army have been taught that their gas mask will protect them absolutely against any gas the enemy may put up. These men, on returning to civil pursuits, carry this idea with them. They will not realize that the extremely poisonous gases used in warfare are chemically active, and, therefore, combine readily with the absorbents of the gas mask. Furthermore, outdoor gas concentrations seldom exceed a few hundredths of 1%. Some of the gases which are successfully absorbed by the mask at these battlefield concentrations will immediately penetrate it when present in quantities of 1 or 2%. In fact, the Army gas mask is useless against many of the most common industrial gases, as, for example, carbon monoxide, ammonia, natural gas, producer and blast-furnace gas, mine gases, coal and water gas, and probably any gas when occurring in concentrations exceding 5%. In such cases the self-contained oxygen breathing apparatus must be used, as the gas mask does not supply any oxygen whatever. In view of these limitations, the gas mask should be used only with the advice of an expert who has a thorough understanding of the limitations of the apparatus.

Reversing Switch for Hoist Motors

High-voltage slip-ring motors built for mine hoists require some form of switch to connect the primary winding to the lines, especially when the motor is used for reversing service. The accompanying illustration shows a new primary oil reverse switch which consists principally of two three-pole switch units, each operated by a high-torque motor.

Among the distinctive features of this switch are the unit-tank construction and the means of lowering the tanks for inspection, repairs, and renewal of oil. Unit-tank construction is used because it increases accessibility, and saves time and labor in identifying the causes



PRIMARY OIL REVERSING SWITCH OPERATED BY TWO HIGH-TORQUE MOTORS

of operating irregularities and making repairs. A double windlass with cables and pulleys permits easy lowering of one or more tanks. The rupture takes place near the top of the oil, so that it is well away from all sediment; and frequent inspections and renewals are unnecessary. The support for the stationary and movable members is bolted to a channel iron, which, in turn, is bolted to the main frame. In case of serious damage to any single-pole unit, the complete unit may be removed without disturbing any of the others. The tanks are lined with a heavy asbestos material, to prevent groundings of any live parts if the tank should be pushed out of place, and also as an additional safeguard in case of sludging of the oil.

The contactor panel shown at the extreme right is controlled from a master switch or push buttons, and handles the motor currents. Little current is required, as the motors used have high-resistance rotors. The reversing switch shown was made by the Cutler-Hammer Manufacturing Co., of Milwaukee, for a 1200-hp. 200-volt mine-hoist motor. It may be used for two motors on non-reversing service, or, where only one non-reversing motor is required, the switch is made with only one three-pole unit and one motor.

"We All Like the Man who sticks through thick and thin." —(Lincoln). Sure! Our men didn't quit even when trapped in the Forest of Argonne. Will you, safe in America, quit in the midst of finishing up your job? Answer with Thrift and War Savings Stamps.

Colloid State From the Electrical Standpoint*

By W. C. McC. LEWIS

As the author of this paper points out, the importance of colloidal chemistry in many problems in hydro- and electro-metallurgy is not realized to the extent that it should be. Many of the so-called proper working conditions aim at the elimination or reduction to a minimum of colloidal interference; or, on the other hand, require the isolation of material in the colloid state. There are, unfortunately, few general ideas which will serve to coördinate the various phenomena met in colloidal chemistry. Owing to lack of space, we are unable to do more than abstract a few details of one of the various problems which are discussed in an interesting and informing paper.

COLLOID chemistry as a science is in a relatively rudimentary state, somewhat in the same condition, in fact, in which the chemistry of solutions of crystalloids stood over 30 years ago, prior to the work of van't Hoff, Arrhenius, and their successors. There are relatively few broad inclusive principles. Information about colloidal systems is disjointed, and phenomena are encountered which cannot be explained.

From the scientific standpoint the chief problems of colloid chemistry are: The conditions which make for the stability of a colloid system. How are stability and electric charge related to one another? What part does the Brownian movement play in this state of stability? Is there such a thing as a stable two-phase system consisting of only two pure substances? What is the mechanism of flocculation? Can flocculation be reversed? Is there anything in common in these phenomena which would lead to a generalization, apart from the specific nature of the material? If specific nature of the material is a determining cause, how can this specific effect be expressed? Is it possible, in fact, to infer from a certain set of observations what the colloid behavior of any given substance will be? How are the effects referred to affected by the presence of other colloids which may act either as stabilizers, peptizers, or coagulants? Is there such a thing as a saturation limit to a colloidal solution? These and other questions readily occur. It is difficult to answer them, however, except in an incomplete manner.

Preferential Ion Adsorption

All are familiar with the electrostatic method of charging a body by friction. The conditions under which this can be effected suggest that it is simply a question of removal of electrons from one surface and their deposition upon the other. Is the electric charge on colloid particles brought about by the same process? An absolutely definite answer cannot be given, but the great bulk of the evidence available points strongly indeed to the conclusion that this is not the case; that, in fact, the charges met in colloid systems are due to preferential adsorption of ions from the surrounding medium. The well-known electrical behavior of albumin, for example, in acid and in alkaline solutions, respectively, is strong evidence for the ion-adsorption view of the origin of the charge on the colloid. Parenthetically, it may be pointed out that if the charge on the albumin sol is due to preferential adsorption of an ion, it should follow that in absolutely neutral solution the albumin particle would not necessarily be uncharged. If, in fact, the hydroxyl ion is preferentially adsorbed, then the point of electric neutrality of the colloid should be found in faintly acid solutions. Information upon this point would be interesting. Whether this effect occurs or not, it is not to be confused with the recent observations of Powis—namely, that coagulation does not coincide exactly with electrical neutrality. This is a new and unexpected result, for which no adequate explanation is as yet forthcoming.

Origin of Charge Due to Ion Adsorption

As further evidence for the adsorption view of the origin of the electric charge, certain other results obtained by Powis on the preparation of colloidal ferric hydroxide may be mentioned. As ordinarily prepared, colloidal ferric hydroxide is positively charged in aqueous solution. It is usually obtained in this form by dialyzing a solution of ferric chloride, the positive charge being attributed to adsorption of ferric ion from the solution, which is relatively rich in this ion. Powis has shown, however, that by allowing a dilute solution of ferric chloride to run slowly into a dilute solution of alkali hydroxide, with constant shaking, a negatively charged colloidal ferric hydroxide can be produced, the charge in this case being attributed to adsorption of the hydroxyl ions. Other evidence in favor of the adsorption view exists.

Certain Colloids Analogous to Electrolytes

In view of the existence of electrolytic colloids such as congo red, the proteins, and like substances, in which it appears that the colloid particle simply functions as an anion, one is led to regard such colloids as analogous to solutions of electrolytes as far as freedom of the positive and negative charges is concerned. But may not this be so in all cases? In this connection brief reference may be made to experiments made by Beans and Eastlack. The results have a direct bearing, at the same time, upon the question as to whether a stable colloid system can be realized with two absolutely pure components, as in the case of a colloidal solution of a metal such as platinum or gold in pure water. At first consideration, and more particularly in view of the mechanical manner in which such solutions can be prepared—namely the well-known Bredig sparking method—such a system appears to consist simply of particles of metal carrying a negative charge in contact with a solvent which is known under ordinary conditions to be chemically inactive toward the metal.

The conditions seem to be the simplest possible in this case. Nevertheless, Beans and Eastlack have succeeded in showing, I think, that the case is not really so simple. They approach the problem from the standpoint of the electrical conductivity which such a system

*Abstracted from a paper on "Properties of the Colloid State and Their Application to Industry," presented at the Birmingham Section of the Society of Chemical Industry on Nov. 14, 1918, and reported in the Jan. 31 issue of that society's Journal.

should possess. A preliminary calculation based upon the known size, charge, and mobility of the particles in a colloidal solution of gold in water showed that the specific conductivity of the colloid itself should be of the order 10^{-10} reciprocal ohms. This is only 0.01% of the conductivity of pure water, so that if the colloidal solution consists simply of finely divided metal in suspension in unchanged water, the conductivity of the solution should not be distinguishable from that of the water itself. This, however, is not the case. The solution exhibits a higher conductivity than that of pure water. Further, there is a marked difference in the enhanced conductivity according to the metal employed. Thus, in the case of colloidal platinum the conductivity is eight times that observed in the case of colloidal gold. Beans and Eastlack connect this larger conductivity with the fact that colloidal platinum is more stable than colloidal gold, their conclusion being that the greater stability of the colloidal platinum is due to the presence of small amounts of electrolyte formed by the oxidation of the metal at the high temperature realized locally in the sparking process. The presence of traces of chloride, bromide, iodide, or hydroxyl ions has a marked stabilizing effect upon these colloidal metals, provided the ions are present already during the sparking process. The conclusion to be drawn from these experiments is that even when the medium is pure—no extraneous electrolyte being added—the stability of the colloid is dependent upon its power of adsorbing or combining with some negatively charged ion, probably, according to these authors, a complex anion containing the metallic atom itself, this complex being produced in the sparking process and conferring the enhanced conductivity upon the solution as a whole. It seems to me that there is no getting away from the conclusion reached by Beans and Eastlack, provided it is possible to be certain about the magnitude of the charge on the colloid particle. If their conclusions be accepted as substantially correct—and I am inclined to accept them—then one may conclude that the presence of a third substance—in the present case the complex anion produced in the sparking process—confers the charge and at the same time stabilizes the colloid particle.

The Hardy-Schultze Law

It has long been known that the addition of small quantities of certain substances, chiefly electrolytes, to suspensions, emulsions, or colloidal solutions brings about an agglomeration and precipitation of the finely divided form. The important rule in this connection is that ions carrying a charge of sign opposite to that carried by the colloid particle are the most efficient coagulating agents, and, further, that the higher the valency of the ion, that is, the greater the number of unit charges upon it, the greater its precipitating action. This is known usually as the Hardy-Schultze law. It is one of the most useful generalizations which investigators possess. At the same time it must not be overlooked that there are certain exceptions to it. This has been emphasized particularly by Bancroft, who advances the not novel explanation that specific adsorption of ions is the real determining factor in bringing about coagulation, rather than the fact of opposite electrical sign. It happens, however, so frequently that the two go hand in hand as almost to justify the Hardy-Schultze rule as a general truth.

On the basis of this rule one would not expect precipitation to be brought about by the presence of a substance having the same sign as that of the colloid. Rather one would expect stabilization, and such, indeed, is generally the case. Thus peptizing agents and protective colloids have in general the same electrical sign as the substance they peptize and protect, that is, retain in the sol form. Nevertheless, there are exceptions. In at least one case a colloid brings about rapid coagulation of a suspension, although the sign of both is the same.

Active Ion of Electrolyte Is Adsorbed by Colloid Sol

As regards the kind of union which takes place between the active ion—that is, the ion with coagulating power—and the colloid sol, practically nothing is known beyond the fact that it is a case of adsorption. That the union is a close one is illustrated by the classic experiment of Linder and Picton in connection with colloidal arsenious sulphide precipitated by barium chloride. In this case the active ion is the positively charged barium ion—the colloidal arsenious sulphide is negatively charged. On examining the precipitate there was found closely adhering to the arsenious sulphide a certain amount of barium in the form of barium hydroxide, which could not be separated by prolonged washing. Simultaneously a quantity of hydrochloric acid was discovered in the supernatant liquid or the filtrate. The whole effect is equivalent to the hydrolysis of the salt.

The Popular Conception of Electrical Action in Preventing Coagulation

The question now arises, Why is it that the partial or total removal of the electrical charge on a colloid particle should cause coagulation to take place? Mr. Hardy first made this clear, in the well-known experiments upon the iso-electric point. The particles are kept in agitation and in a certain spatial distribution throughout the medium, as Perrin has shown, as a result of the Brownian movement, that is, as a result of the unordered collisions with the molecules of the solvent or medium. Brownian movement, therefore, has a double function in colloidal chemistry. As a result of the bombardment of a single colloid particle by the molecules of the medium, the particle is kept in suspension; this effect is essential to the permanence of the colloid state. On the other hand, the movement so imparted to the colloid particles must cause the colloid particles themselves to collide with one another; and, if the conditions are favorable, the collisions will result in permanent union, ultimately producing coagulation when the particles have grown to sufficient size.

The function of the electric charge as a stabilizing agency for the sol form is supposed to consist simply in the fact that particles carrying electricity of the same sign repel one another. Coagulation is thereby prevented. This is an exceedingly plausible view of the case, but one is scarcely satisfied that it is comprehensive. It would be a decided advance if this qualitative idea could be formulated in a quantitative expression amenable to experimental test. The difficulty of accepting this simple view lies in the fact that peptization and protection—which depend upon adsorptive effects—occur between particles of the same electric sign, and therefore presumably repelling one another.

A further set of phenomena is associated with the existence of electric charges upon colloids and upon in-

terfaces in general, namely, electrical endosmose and cataphoresis. A considerable amount of information respecting the origin of these phenomena is due to Perrin, Bancroft, Briggs, and others. Though selective adsorption again plays an essential part in these cases, it must be recognized that available information is rather qualitative than quantitative. The next development of colloid chemistry must be toward quantitative expression in general.

The real trouble in all this is the fact that scientific colloid chemistry has not advanced nearly enough to meet the requirements of present-day technical practice. Many of the technical operations in this field are consequently empirical—a state of affairs which no one can regard as satisfactory. I have indicated how the whole range of scientific colloid chemistry bristles with unanswered questions. The fact is that colloid chemistry is only beginning to be thought about seriously. Even at the present time it has not generally appeared as a distinct subject for instruction and research in British universities and colleges. One cannot hope for real advances in colloid technology until scientific colloid chemistry is put on a proper footing and receives the attention which its fundamental importance deserves.

Lead Plating*

According to a circular issued by the Bureau of Standards in collaboration with the Army Ordnance Department, lead plating is conducted similarly to any other plating operation, and can be readily achieved wherever there are plating facilities and an experienced plater. Wooden tanks, preferably lined with asphalt or bitumen, are suitable for the purpose; iron or lead linings should not be used. The solutions after mixing are not especially corrosive, nor so poisonous as many other plating solutions in common use. Danger of lead poisoning may be avoided by the use of the customary precautions. Briefly, the operation of lead plating consists in hanging the properly cleansed articles in the plating solution upon the cathode rods, and lead plates or sheets of suitable size upon the anode rods.

The only two lead-plating media in extensive commercial use are the fluosilicate and fluoborate solutions. The former is made by dissolving lead carbonate in fluosilicic acid, which in turn is prepared by the action of hydrofluoric acid on silica. As the preparation of the fluosilicate solution is a complicated process, it is customary for the platers to purchase this solution from the refineries in which it is used on a large scale for the refining of lead. Observation has shown that most of the platers using fluosilicate solutions make further additions to the solutions as purchased, such as glue, molasses, and oxalic acid. The fluoborate solution is prepared by dissolving boric acid in hydrofluoric acid, and then adding the lead carbonate (in the form of a paste), and the requisite amount of glue, after which the solution is diluted to the desired volume or density. Dense, satisfactory deposits of lead can be produced in either the fluosilicate or fluoborate solution, but it is believed that for new installations the fluoborate solution will be most satisfactory. The fluoborate solution may be used to plate directly on steel, whereas in the fluosilicate solution the steel must first be copper-plated or receive other special treatment.

*Abstracted from an article in the *Brass World*, and reprinted in the *Journ.* Franklin Institute, February, 1919.

Aluminum Alloys*

Aluminum was merely a scientific curiosity a generation ago, the production in 1883 having been but 83 lb.; but it is now one of the most common metals in use, with an annual production of hundreds of thousands of tons. It is most important in its alloys, especially in those with magnesium and copper. The alloy known as magnalium is a series of mixtures containing 10 to 30% of magnesium; it is silver-white in appearence, strong, ductile, easily cast, takes a fine polish, and has a specific gravity of only 2 to 2.5, somewhat less than that of aluminum itself. With 10% of magnesium the melting point is between 650° and 700° C. The metal is made harder, more brittle and finer in polish by additions of magnesium up to the practical limit of 30%; it may be given a dark color by maceration, or it may be nickeled or gilded. Duralumin, with 3.5 to 5.5% of copper and about 0.5% each of magnesium and manganese, has greater hardness, tensile strength and polish, and may be easily hardened, but it is given special value by its resistance to the action of sea water and dilute acids. It is a little heavier than aluminum, with a specific gravity of about 2.8. Other alloys, similar to magnalium, but adapted to special uses, contain small percentages of nickel, tin, lead, and iron.

Mining Partnership Rights

BY A. L. H. STREET†

Plaintiff and defendant became co-partners for the location of mines in the Sitka mining district, Alaska. They made discovery in 1911, and a location in plaintiff's name for the equal benefit of each. Together they did the assessment work for 1912, and plaintiff alone did it in 1913. As plaintiff was returning to Seattle, defendant promised to do the work for 1914, but failed to perform it. The claim being open to relocation, because of this default, defendant caused a third person to relocate it for defendant's own benefit, and became interested in adjacent claims which he located with a fourth person. Later all the claims were sold, and plaintiff, on discovering the facts, sued for an accounting.

In upholding plaintiff's right to recover on the basis of equal partnership with defendant, the Washington Supreme Court said in this late case (Kittilsby *vs.* Vevelstad, *173 Pacific Reporter, 744*):

> His [defendant's] failing to do the work as promised, and his secret method of obtaining the claim . . . cannot be sanctioned. Good faith would require him to notify his partner that the assessment work as promised by him would not be performed.

Numerous authorities are cited by the court in support of the legal proposition that the existence of a partnership creates the highest fiduciary relationship between the members, precluding one partner from fraudulently deriving secret benefits at the expense of his associate or associates.

Quebec Chromite Production in 1918 was 35,749 tons, valued at $770,955, according to the preliminary report of the Quebec Bureau of Mines. The tonnage includes the shipments of crude ore and ore sent to concentrators. Actual shipments of crude ore and concentrates in 1918 amounted to about 21,500 tons.

*Abstracted from an article in the *Chemical Trade Journal and Chemical Engineer*, and reprinted in the *Journ.* Franklin Institute, February, 1919.

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Notes on Water-Power Development*

By D. H. Colcord

Certain economic and legislative factors have taught the uninitiated investor in "hydro-electrics" several costly lessons in recent years, and it seems worth while to review these considerations:

1. Load factors have been overestimated.

2. Drouth in summer and ice in winter have prevented the constant source of power counted upon. The initial cost for building impounding dams to overcome this difficulty has often been so great that, although companies might eventually have succeeded, during their establishment and initial operation they could not compete with steam-power companies.

3. The high cost of transmission systems in a mountainous country has been prohibitive in some cases.

4. The cost of installation is high. In 1914, the total cost of installing hydro-electric plants was estimated at $27,000,000, including distribution systems and auxiliary equipment. This gives an average cost per horsepower of $158. A general estimate of the cost complete, as given by a prominent engineering company, not including distribution or step-down transformers, has ranged from $75 to $150 per kilowatt installed. If the price of coal increases, in time it will compare favorably. At least the marginal difference in cost will demand increased efficiency in the operation of hydro-electric plants, which might make up for this difference. The best steam practice secures at the electric generator less than 20% of the energy stored in coal, though the efficiency of the water wheel frequently exceeds 90%, which is worth considering.

5. The rapid development of the steam turbine, with its increased efficiency, has discouraged the utilization of water power.

6. Distance from the market has been an adverse factor in many instances.

7. The value of land in industrial districts has restricted development.

8. Railroads have followed the streams, and in many instances would have to be rebuilt.

9. Many of the streams are of an interstate, interprovincial, or international character, and their use would involve legislative difficulties.

10. The fact that several projects have been started and abandoned has had a bad moral influence.

11. Long-term franchises held by municipal heating and lighting companies made competition impossible.

12. The forestry laws contain inadequate provisions for the leasing of land.

13. There is a scarcity of good head sites.

14. Not enough data are available on the geological features of stream beds.

15. The recent scarcity and high cost of labor and building material have prevented, since the war, the completion of developments already started.

The 1916 report of the Pennsylvania Water Commission contains data on hydro-electric projects that have been started and dropped for various reasons.

Projects were begun at a time when there was a marked scarcity of capital. The companies failed to realize the necessity for a complete engineering survey. Improper sites were chosen and then abandoned. Hydrographic conditions were overestimated, and in some cases there was not as much water available as counted upon. Commercial surveys were not always thorough, and companies in some cases overestimated their markets for power. In three instances uncertainty in regard to the legal rights possessed by the companies, and subsequent legislation, blocked their progress. In several projects, the blame for failure can be ascribed to financial misfortune.

The general advantages derived from water-power developments are:

1. The highest use of coal is to create heat to preserve man's life, and the term of man's existence may depend on the care of the supply. Fuel is not essentially reproductive. Water power for industry can save millions of tons of coal a year.

2. The industrial section depends primarily on fuel, and any effort to conserve fuel supplies will lengthen productive life.

3. The electrification of all railroads is inevitable, and provision must be made to supply the electric power. As railroads follow the streams, the natural source of power is that which is the most available—the stream itself.

4. Water power makes electric lighting possible wherever it is needed.

5. Where steam power is already used, it can be supplemented by water power.

6. Storage reservoirs used with hydro-electric plants are a protection against floods.

7. During the drouths in summer, the expulsion of water from impounding dams improves sanitary conditions along the stream below.

8. Impounding dams on rivers often improve navigation.

9. Thickly settled districts afford a large market for electric power, with reasonable transmission distances.

10. Old canals and dam sites often make it possible to install a plant at small cost.

11. There are many limestone streams in mountainous districts that have a high rate of flow during the dry seasons.

12. Labor released by the winning of the war can be used to build the plants.

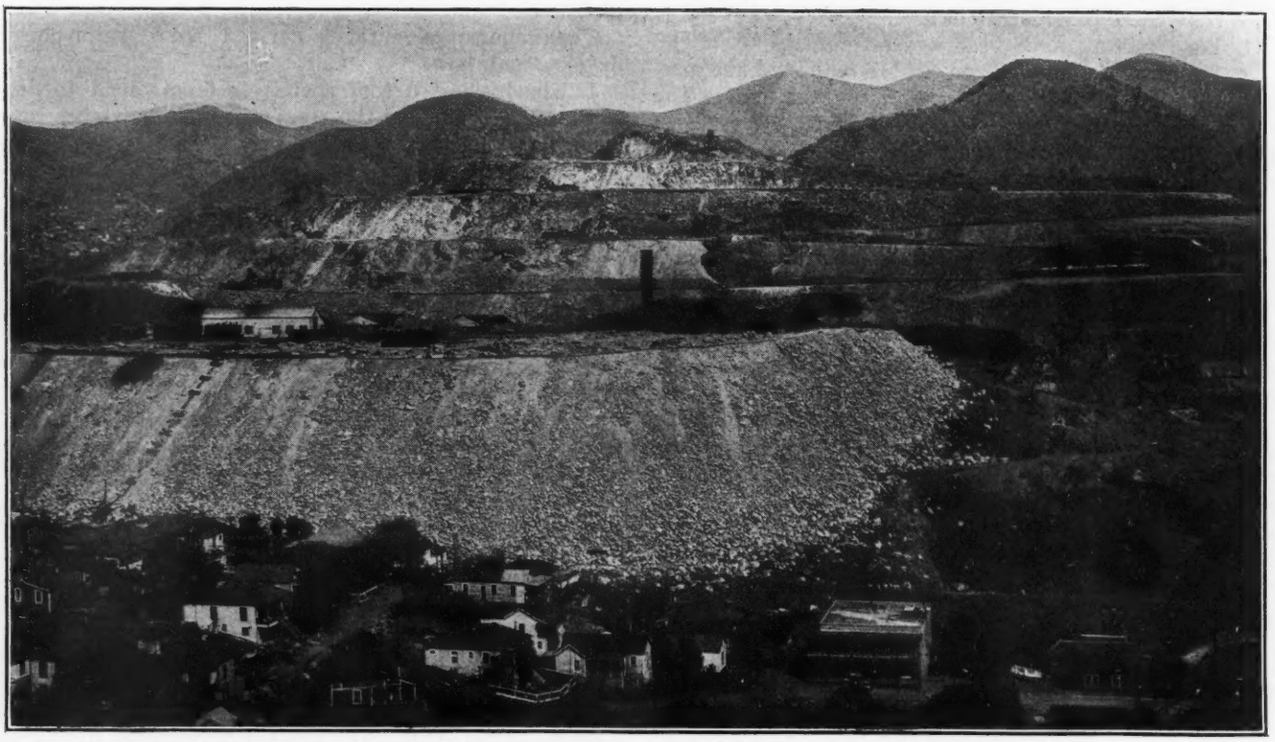
13. Increased industrial efficiency is effected, because of labor saving and waste prevention in distributing power.

From a conservative and absolutely safe standpoint, considering immediate returns on the investment, the correct policy is to use water power only to supplement steam where coal is available at a fair price. But this policy is somewhat pinched and near-sighted from national, industrial, and economic standpoints, because the time is coming when the available coal will be gone.

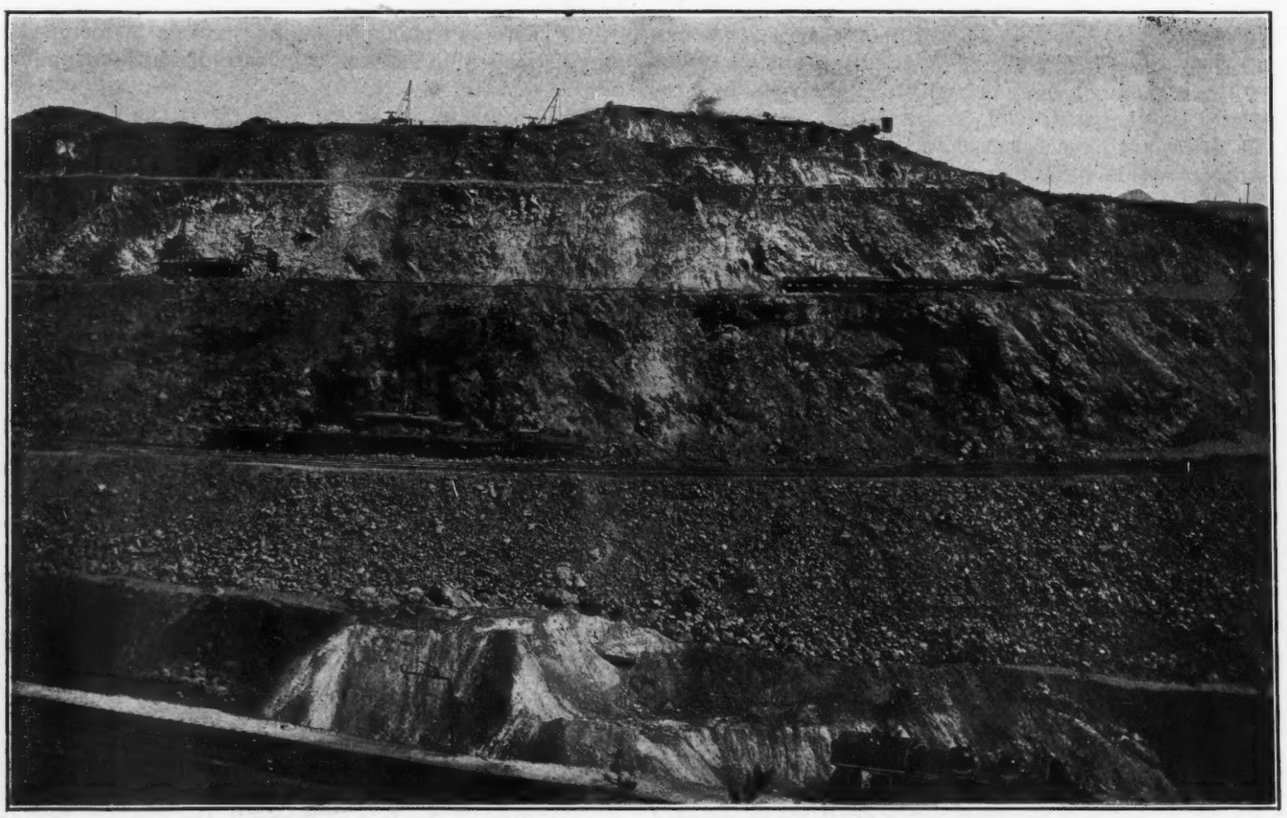
In Great Britain, proposals have been set forth for vast central-station power plants, and computations and records are being made of all of the water powers of the British Isles. Since the outbreak of the war, the Italian government has proceeded with an active water-power policy. In 1917 and 1918 concessions have been granted for 1,024,000 hp. Norway has developed 1,120,000 turbine hp. and plans to sell hydro-electric power to Denmark. Barcelona, in Spain, is replacing steam power by hydro-electricity. In Switzerland, 25% of the 2,000,000 available hp. has been developed. A Canadian company has completed a large portion of an extensive system of reservoirs and hydro-electric stations on the Nogurea, Pallareasa, and Segre rivers. All this is indicative of the fact that people are laying a lasting foundation for power for years to some.

*Abstracted from the *Canadian Engineer*, Jan. 23, 1919, p. 170.

Stripping Operations at Sacramento Hill

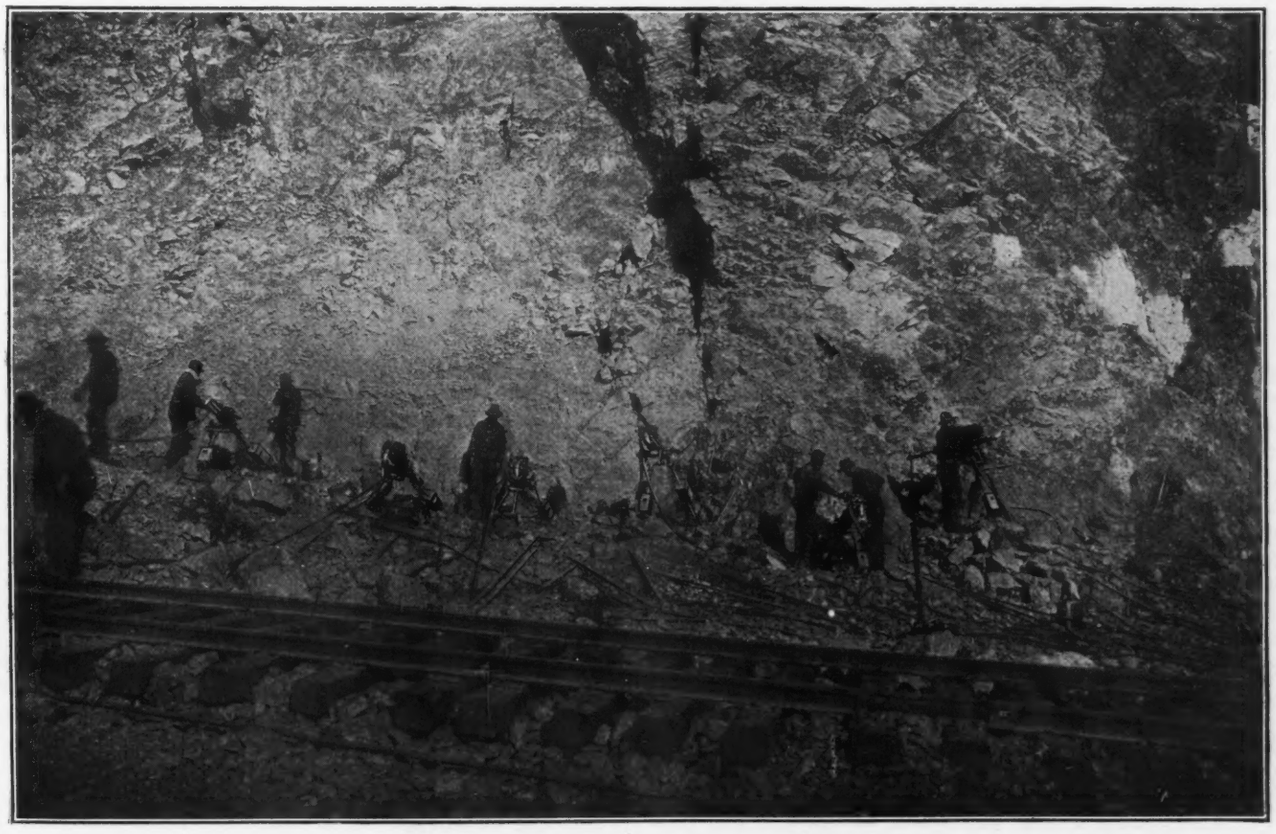


SACRAMENTO HILL, WHICH IS BEING STRIPPED BY THE PHELPS DODGE CORPORATION



ARRANGEMENT OF BENCHES AT SACRAMENTO HILL, BISBEE, ARIZONA

DRILLING OPERATIONS ON THE UPPER BENCH AT SACRAMENTO HILL



MACHINE DRILLING TOE HOLES AT SACRAMENTO HILL

Rand Mining in 1918

BY A. COOPER KEY*

The operation of the Rand goldfield during the last year was hampered by exceptionally severe floods, high prices for labor and materials on account of the war, shortage of labor, and the influenza epidemic. In view of these many disabilities, the production has not dropped to an extent that might have been expected, but profits show a considerable decline. Data are given to show the past and present position of the industry; and the importance of the Far East Rand as the principal source of future yield is emphasized by illustrative chart, tables and figures.

WATER troubles, due to excessive rains in the first two months of the year; the influenza scourge in September and October, and a consequent shortage of native labor attributable to the suspension of recruiting; and the influenza pandemic in Portuguese East Africa, which is a very important area of supply, combined to make the Rand's record for 1918 an indifferent one. Production has kept up fairly well, but the profits of the gold industry, which were £1,000,000 a month before the war and in 1915, and but little short of that figure in 1916, have fallen to an average of about £600,000, and November and December they approximated only £500,000. During these two months the shortage of labor was felt with full force, there having been a decrease of over 20,000 natives on the payrolls.

THE TRANSVAAL GOLD MINES' FIGURES

The gold output of the Transvaal—and there are a few mines working outside the Rand—is given by the Chamber of Mines at £35,768,688, as against £38,323,921 in 1917, and £39,484,934 in 1916. There has thus been a shrinkage of over £2,500,000 in the year and of nearly £3,750,000 in two years. Several of the important mines of the Central and Near East sections of the Rand are nearing exhaustion, with consequent lowering of grade and reduced numbers of stope faces. The ore milled in 1918 aggregated 25,250,000 tons, in contrast with 27,750,000 and 29,250,000 tons, respectively, during the previous two years. But this decrease in tonnage is neutralized to some extent by the rise in grade, the recovery having steadily risen since 1915, when it stood at 26s. 3d., to 26s. 8d., 27s. 1d. and, now, 27s. 11d. In the three years there has been an improvement of 1s. 8d. in the value of the average amount of gold recovered on the Rand. This is attributable to the higher grade of ore being mined in the Far East Rand, where recovery ranges from 35s. to 40s. and even 45s. per ton. An advance of 20d. in grade (shown in the three years) means an increase of £2,000,000 in 1918.

RAND FIGURES CONSIDERED SEPARATELY

The Rand taken by itself yielded gold to the value of £34,823,017 in 1918. Production in 1918 was surpassed in the years 1912, 1913, 1915, 1916, and 1917, but it is higher than that for 1914, by £700,000. The Government Areas mine is now producing £200,000 worth of gold monthly, and making a profit of £85,000, about 45% of which goes to the Union government as royalty. Crushing was begun in November, 1914, whereas Modder Deep, now responsible for £85,000 gold and £50,000 profit a month, started milling in January, 1915. In the interim, Springs Mines (£85,000 output and £40,000 profit) entered the producing stage, and the new battery at the Circular shaft at the New Modderfontein has brought that company's monthly yield up to £167,500, giving a remarkably regular profit of £90,000. The average value of the gold recovered from the Rand mines last year was 27s. 11d.

MARKED RISE IN WORKING COSTS

Working costs have averaged 21s. 7d. per ton, and December, on the lessened tonnage due to labor shortage, showed the somewhat alarming figure of 23s. True, November is the highest average for a dozen years, representing an advance of 2s. 6d. on the year, and of more than a pennyweight (say 4s. 6d.) compared with 1914. Stores at high prices, war bonus to married workers and to single men with dependents, payments to men in active service—these are the principal factors in the advance. It may be observed that, if the recovery were no higher than it was in 1914 (and the strength of a gold field lies in its ability to treat enormous tonnages of medium- and even low-grade ore at a profit), the profit on the abnormally high rate of December would be no more than 3s. 6d. per ton. The actual figure was 6s., as against 7s. 6d. in 1917 and 8s. 2d. in 1916.

PROFIT DROPS SHARPLY TO £7,500,000

The factors of decrease in tonnage and augmented costs have slumped the Rand profit to £7,500,000, as against £10,250,000 in 1917 and £11,500,000 in 1916. Never since the Chamber of Mines first started to collect the profit data from the companies had the amount previously dropped below £10,000,000. Last year's total is actually £5,000,000 less than that of 1912, and £4,500,000 below that of 1908, when the quantity of rock crushed was 6,750,000 tons less than in 1918. This is a poor result from the investor's standpoint, although the increased expenditure has brought enhanced prosperity to the Rand, the population of which is retaining an ever-increasing proportion of the gold which filters through the pockets of a comparatively small number of white people. The growth of expenditure in relation to output is shown herewith:

EXPENDITURE AND OUTPUT ON THE RAND

	Output	Expenditure	Per Cent. of Expense to Output
1914	£34,124,434	£21,943,692	64.2
1915	37,264,992	24,657,659	66.2
1916	38,107,909	25,763,270	67.6
1917	37,017,633	26,129,156	70.6
1918	34,823,017	26,848,547	77.1

THE HIGH COST OF WINNING GOLD

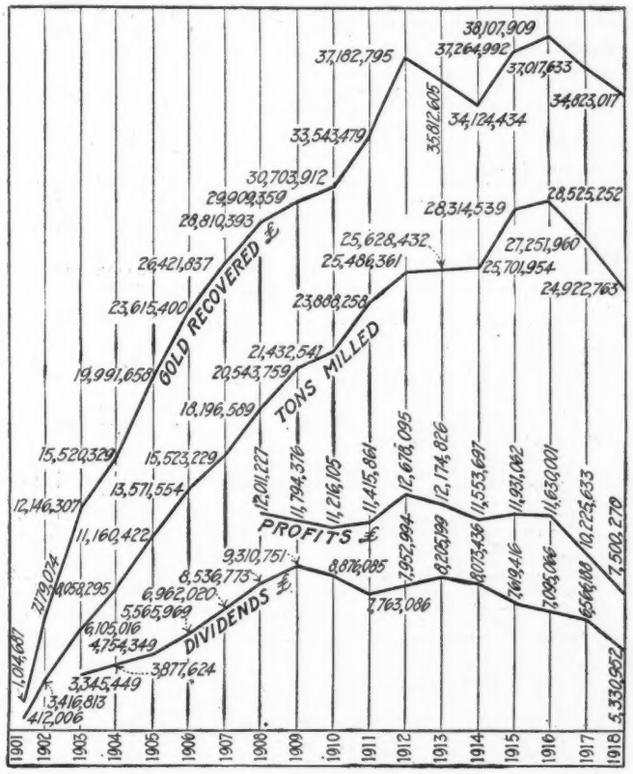
In the five years the gold output has advanced by £700,000, but the expenditure has increased no less than £4,900,000. A decade ago the mines of the Rand spent altogether only about £18,000,000 a year, but made much larger profits. In 1915 it cost 13s. 4d. to win gold worth £1, but the expenditure last year to achieve this was 15s. 5d. Thus it costs 77c. to procure $1 in gold. In

*71 Permanent Buildings, Johannesburg, South Africa.

some businesses in Johannesburg "profiteering" has gone on during the war unchecked. One wonders how a profit of only 4s. 7d. on every sovereign of turnover would appeal to these gentry. This is only after the vast expenditure of capital, and even that modicum of profit is subject to government taxation and contributions under the Miners' Phthisis Act.

The Dividend Aspect

The Chamber of Mines gives the amount of dividends actually declared during the year 1918 at £5,144,077, but to this it appears correct to add £115,000, the first dividend of Springs Mines paid on next spring's scrip, and convertible at par by the Anglo-American Corporation, and also £71,875, the second half-yearly dividend of the Geduld Proprietary Mines payment, deferred for



OUTPUT, PROFITS AND DIVIDENDS (IN POUNDS STERLING) AND TONS MILLED ON THE RAND 1901-1918 (INCLUSIVE)

a few weeks owing to issue of further capital. This brings the total to £5,330,952. The margin between profits and dividend distributions is narrower than usual, namely less than £2,250,000, compared with previous disbursements of £3,500,000, £4,000,000, and as much as £4,750,000 in 1912. There has latterly been less diversion of profits to capital expenditure.

Spectacular Advance of Far Eastern Mines

The companies of the Far East Rand (Benoni, Brakpan, and Springs districts) contributed no less than £3,401,500 of the dividends, representing 64% of the total, as against 43% in 1917. The dividend decline of the Central Rand was accentuated in the second half of the year, when the distribution was only £708,500, about £1,000,000 below the payments by the Far Eastern group. Three companies paid out over £500,000—New Modder, £726,250; Modder B £577,500, and Van Ryn Deep, £538,600. Modder Deep distributed £487,500, and Government Areas, £385,000, a somewhat similar sum accruing to the Union government. The comparison of Central and Western with the Far East is as follows:

	First Half 1918	Second Half 1918
Far East Mines	£1,632,270	£1,769,247
Central and Western	1,220,964	708,485
Totals	£2,853,234	£2,477,732

Though all the Far Eastern Mines except Modder B recorded an increase in dividends, the Modder an increase of no less than £236,250, and Government Areas £210,000 (two dividends instead of one), there were some serious declines in the Central section. Most noteworthy was a £218,750 decrease by the City Deep, on which at one time the mantle of the historic Robinson was said to have fallen; whereas that great amalgamation, the Crown Mines, paid only £188,000, exactly half the 1917 distribution. Old age, high costs and lower grade explain decreases of £150,000 at Simmer and Jack; £137,500 at the Robinson, and £110,000 at the City and Suburban. High costs and mining difficulties due to great depth account for a decrease of no less than £132,000 at the Village Deep. The dividends of what may be called the "Golden Four Miles" to paraphrase a western Australia appellation (from the Wolhuter to the Crown Mines), decreased practically £1,000,000 during the year. Sir Evelyn Wallers, President of the Chamber of Mines, at a recent inspection of the New Modderfontein circular-shaft plant, humorously remarked that the Wise Men of the Scriptures came from the East, but the wise people of the Rand had, on the contrary, gone to the East. And so it is.

Quicksilver in California

Bulletin 78 of the California State Mining Bureau, entitled "Quicksilver Resources of California," by Walter W. Bradley, is now ready for distribution. It is the first work published in 15 years dealing distinctly with quicksilver and its metallurgy and has had only two predecessors in this particular field—G. F. Becker's "Geology of the Quicksilver Deposits of the Pacific Slope" and William Forstner's "Quicksilver Resources of California."

California yields approximately 70% of the quicksilver output of the United States, and since 1850 has produced a total of 2,137,728 flasks (to the end of 1917), valued at $101,992,560. Bulletin 78 contains production and price charts, which show the annual fluctuations of values and quantities, and the entire work is illustrated with photographs, drawings, and geological maps. The section on metallurgy contains numerous photographic cuts and line drawings of furnaces, condensers, and other plant equipment. A drawing of the rotary furnaces of the New Idria Co. is included.

The metallurgical work detailed includes an account of the author's original investigations relative to concentration methods as applied to quicksilver ores, which included treatment on tables with water, flotation with oils, and solution by an alkaline sulphide.

The quicksilver industry, though, relatively speaking, not large or extensive, is, nevertheless, a vital one in peace times as well as in war. Under normal conditions 50% of the quicksilver consumption goes into fulminate for blasting caps for quarrying and mining, as well as for ammunition. In addition, a considerable amount goes into the manufacture of drugs. Some also is used in gold and silver mining.

United States Steel Corporation

THE United States Steel Corporation's report on operations during 1918 contains the record of a great industry and describes its many unusual activities made necessary by America's participation in the war. Deviating from its previous industrial course, the operations of the corporation during the period covered by the report have been multifarious, and the record that has been made under conditions of stress, high costs, and labor uncertainties reflects great credit on the various managements, whose foresight and business acumen have made the accomplishment possible.

The general balance sheet, condensed, is as follows:

GENERAL BALANCE SHEET U. S. STEEL CORPORATION
Year Ended Dec. 31, 1918

Assets	
Property account, less depreciation	$1,563,937,122.89
Advanced mining royalties	20,562,090.12
Mining royalties	33,912,076.17
Deferred charges	1,751,649.41
Investments	4,947,972.53
Sinking fund assets	63,370,182.27
Current assets	883,136,081.69
Total assets	$2,571,617,175.08
Liabilities	
Common stock	$508,302,500.00
Preferred stock	360,281,100.00
Stocks of subsidiary companies not held by U. S. Steel	434,642.50
Bonded debt, U. S. Steel Corporation	414,928,000.00
Bonded debt, subsidiary companies	167,718,168.74
Notes subsidiary companies	33,912,076.17
Mortgages and purchase money	651,952.15
Current liabilities	397,781,482.33
Reserve funds	109,819,917.71
Appropriated surplus	110,898,914.10
Undivided surplus	466,888,421.38
Total liabilities	$2,571,617,175.08

Of the current assets, materials and products on hand are represented by $274,753,600.02; accounts receivable, $113,810,679.39; and cash on hand, $173,806,259.41. The net income for 1918 amounted to $158,631,856.20, and is shown in condensed form in an accompanying table. From the net income is deducted $21,728,932.84 in interest and premiums, and an adjustment of $629,453.96 brings the balance to $137,532,377.32. Total dividends paid during 1918 amounted to $96,372,027, preferred stock receiving 7% and the common a 5% regular dividend and 9% extra. These total $25,219,677 for the preferred and $71,162,350 for the common stock. After deducting dividends and an additional allowance of $12,215,000 to cover amortization of proportion of cost of facilities installed for production of articles contributing to prosecution of the war, $28,935,350.32 remains as a balance carried forward to undivided surplus.

Total domestic shipments for 1918 were: Rolled steel and other products, 12,384,169 tons; pig iron, ingots, spiegel, ferro, and scrap, 307,482 tons; iron ore, coal and coke, 1,009,919 tons; and sundry materials and byproducts, 192,925 tons. Universal portland cement shipped equalled 7,707,595 bbl., a decrease of 25.9% from shipments of 1917. Domestic business during 1918 was valued at $1,125,161,264, an increase of 9.6% over that of 1917.

The export business for the year was valued at $162,867,991, a decrease of 9.3% from that of 1917. Shipments were: Rolled steel and other finished products, 1,740,817 tons; pig iron, ingots, and scrap, 17,120 tons, and sundry materials and byproducts, 2305 tons. Total tons of all kinds of materials, 1,760,242, which is a decrease of 19% from shipments of 1917.

Operations of subsidiary companies during 1918 did not reach the totals for the preceding year, notwithstanding the large and constant demand for iron and steel products. About 65% of the entire steel-products output for the corporation was supplied to Government departments. The total production during 1918, in comparison with results in 1917, was as follows:

TOTAL PRODUCTION IN 1917 AND 1918

Products	1917 Tons	1918 Tons
Iron Ore Mined		
In the Lake Superior Region		
Mesabi Range	23,806,268	21,574,526
Vermilion Range	1,039,807	808,994
Gogebic Range	2,197,554	1,916,220
Menominee Range	1,120,382	1,172,319
Marquette Range	491,760	338,344
In the Southern Region		
Tennessee Coal, Iron & R.R. Co.'s Mines	3,125,998	2,522 536
Totals	31,781,769	28,332,939
Limestone quarried	6,494,917	5,141,365
Coal Mined		
For use in the manufacture of coke	24,554,525	25,393,155
For steam, gas and all other purposes	6,942,298	6,354,980
Totals	31,496,823	31,748,135
Coke Manufactured		
In bee-hive ovens	11,177,247	9,962,403
In byproduct ovens	6,284,428	7,795,233
Totals	17,461,675	17,757,636
Blast-Furnace Production		
Pig iron	15,460,638	15,700,561
Spiegel, ferromanganese and silicon	192,290	240,393
Totals	15,652,928	15,940,954
Steel-Ingot Production		
Bessemer ingots	6,405,390	5,630,246
Openhearth ingots	13,879,671	13,953,247
Totals	20,285,061	19,583,493
Rolled and Other Finished Steel Products for Sale		
Steel rails (heavy and light tee and girder)	1,594,196	1,471,508
Blooms, billets, slabs, sheet and tinplate bars	1,692,348	1,489,737
Plates	1,473,625	2,171,362
Heavy structural shapes	1,004,537	1,079,601
Merchant steel, bars, hoops, bands, skelp, etc	2,650,970	2,159,279
Tubing and pipe	1,234,129	1,190,594
Wire rods	267,071	209,350
Wire and products of wire	1,821,985	1,445,567
Sheets (black and galvanized) and tin plates	1,740,949	1,356,119
Finished structural work	550,744	503,380
Angle splice bars and all other rail joints	207,846	145,305
Spikes, bolts, nuts and rivets	91,980	67,514
Axles	220,291	141,480
Steel car wheels	110,014	84,331
Sundry steel and iron products	282,226	334,356
Totals	14,942,911	13,849,483
Spelter	67,418	41,715
Sulphate of iron	43,942	42,321
Fertilizer	11,574	12,022
	Bbls.	Bbls.
Universal portland cement	10,917,000	7,287,000

Unfilled orders of subsidiary companies on Dec. 31, 1918, totaled 7,379,152 tons of rolled-steel products, in comparison with 9,381,718 tons at the close of 1917.

Three general wage advances were made during 1918 to employees of the subsidiary manufacturing and iron-mining companies, as follows: Apr. 16, 15%; Aug. 1, 10%; and on Oct. 1 plants were placed on the basic eight-hour day, with time and one-half for overtime, which was in effect an increase in wage rates of about 10% The number of employees and total payroll are shown in an accompanying table.

EMPLOYEES AND PAYROLLS

Employees of	1917 Number	1918 Number
Manufacturing properties	198,711	199,029
Coal and coke properties	26,189	28,378
Iron-ore properties	13,198	12,619
Transportation properties	26,210	25,055
Miscellaneous properties	3,750	3,629
Totals	268,058	268,710
Total salaries and wages paid	$347,370,400	$452,663,524
Average Salary or Wage per Employe per Day:		
All employees, exclusive of general administrative and selling force	$4.10	$5.33
Total employees, including general administrative and selling force	$4.16	$5.38

Expenditures made during the year for acquisitions of additional property, new plants, and for extensions and construction, including net stripping and development expense at mines, totaled $129,855,038. The greater part of the work was carried out for the purpose of increasing facilities and utilizing the existing capacity to its maximum to meet the demand for steel of the military and naval requirements, including the Government shipbuilding program. Among the important additions and improvements were: Construction of modern shipbuilding plants on the Hackensack River, near Newark, N. J., and on the Chickasaw River, near Mobile, Ala.; byproduct coke plants at Clairton, Penn., Lorain, Ohio, and at Cleveland, Ohio, each plant having also benzol departments; and at Gary, Ind., at Fairfield, Ala., (the latter involving additional byproduct coke ovens); and at Duluth, Minn., where a benzol-recovery department was installed. At the McDonald plant of the Carnegie Steel Co. large additional expenditures were made in the installation of merchant bar steel mills, four additional mills having been placed in operation during the year. At the Gary, Ind., plant of the Indiana Steel Co., two new merchant bar mills and a forged-steel wheel plant were completed. The American Bridge Co. erected at Gary a plant for the manufacture of gun forgings. The Christy Park plant of the National Tube Co. was materially enlarged, and equipment was installed for manufacture of torpedo air-flask forgings and other war materials. At the Worcester and New Haven plants of the American Steel and Wire Co., large additional expenditures were made for increasing the productive capacity of wire rope and cable and of wire for military and naval purposes. At several plants of the American Bridge Co. additional special equipment was installed for producing fabricated shapes for ships, and expenditures aggregating $9,578,774 were made at various places for acquirement of property, development of sites, and construction of dwellings for employees, and for installation of public utilities in connection therewith. Nearly 5000 houses were completed or under erection during the year. The outlays for these purposes were large, but necessary to the maintenance of a satisfactory and permanent force of employees.

INCOME 1918—U. S. STEEL CORPORATION

Gross receipts	$1,744,312,162.97
Operating charges	1,515,110,651.20
Balance	$229,201,511.77
Royalties and rentals	19,168,489.19
	$248,370,000.97
Other income	21,306,334.83
	$269,676,335.79
Less adjustments and charges	61,395,231.56
Total earnings	$208,281,104.23
Interest and depreciation	49,649,248.03
Net income for year ended Dec. 31, 1918	$158,631,856.20

During 1918, a total of $709,059.82 was disbursed in pensions among retired employees. The privilege of subscribing for shares of common stock was again offered to employees at the price of $92 a share, under substantially the same terms as those offered in past years. There was expended during 1918 for safety work, $1,110,064, and fatal and serious accidents showed a decrease of 7.64% from 1917. The total amount disbursed by all companies during 1918 in connection with accident relief was $3,336,459.

During 1918, the sum of $2,713,166.35 was spent by the iron-ore mining subsidiary of the corporation, and the amount includes the cost of exploring and opening new ore deposits, additional surface land at Hibbing, Minn., and the following additions to plant construction: Aragon mine: equipping mine for electric operation. Norrie-Aurora mines: equipping Norrie shaft "A," East Norrie shafts "C" and "D," Aurora shaft "E" and Pabst shaft "H"; underground pumping equipment at Norrie shaft "A"; central electric power plant at Pabst shaft "G"; equipment for sinking Pabst shaft "H." Canisteo district: additional boilers and electric generating equipment at power plant; extending power-transmission lines; equipping shops with electrically operated machinery. Canisteo mine: water-supply system; car-wheel lathe, account car-repair shop and locomotive crane. Arcturus mine: track spreader, track shifter and tie-tamping outfit. Chester mine: air compressor. Hartley mine: track spreader and track shifter. Hibbing district: car-repair shop; warehouse; hospital; 40-in. boring mill. Morris mine: ore-crushing and screening plants. Leonidas mine: car-repair shop; enlarging general repair shop; coaling station; additions to power plant; rearranging tracks from mine pit. Eastern Missabe district: new concentrator plant for washing ore; ore-crushing plant and yard tracks. Adams district: coaling station and water tank, account water-supply system; double-track bridge over Duluth and Iron Range R.R. tracks. Virginia district: car-repair shop; storage warehouse.

A part of the statement is devoted exclusively to the description of the corporation's war activities. The American Sheet and Tin Plate Co. furnished nearly all the steel sheets used by the War Department to make helmets; the National Tube Co. designed and delivered large quantities of gas shells; the American Bridge Co. fabricated a special railway mount for naval guns, sending technical experts to France to complete the work. The corporation's Lake fleet organization contracted with the Government to deliver at Montreal and Quebec the boats commandeered by the Shipping Board, some of which had to be cut in two before they could be sent through the locks. When the Government conceived the project for a giant ordnance plant near Pittsburgh, the corporation was put in charge of the construction and operation of these works. The corporation sent a special committee of engineers to study the projectile plants of England, France, and Italy, and, besides, released 64 of its trained experts for the task of erecting the new plant. The armistice brought the work to an end.

Use of Tractors in Ore Haulage*

The ore-hauling problem of the Phillipsburg Mining Co., Phillipsburg, Mont., was solved by the installation and operation of three caterpillar tractors. By this method of transportation the company has been able to overcome the handicap of bad roads and successfully move its ore from the mine to the shipping point. Each of the tractors handles six 35-ton wagons of manganese ore to a load, and hauling is done by day and night shifts throughout the year. At the completion of a round trip, each tractor is replenished with a supply of fuel and oil and carefully inspected to see that all bolts are tight and that every part of the mechanism is in proper working order. Periodically the cylinder oil is drained out, the crank case cleaned, and a new, fresh supply of oil put in. The operation of the tractors has proved highly successful.

*Abstract of an article, "Freighting Manganese Ore," which appeared in *Caterpillar Times*, March, 1919.

Correspondence and Discussion

Business Opportunities in France

Ever since the first appearance of the flaming publicity campaign in the United States regarding the opportunity for business in France the sentiment here has been frankly, *"France pour les Français."* Our American publicity was so pronounced that we seemed to consider France as our commercial colony. The result was that sentiment against importations developed to such an extent that it has not been possible for linen manufacturers in the north to import machinery from England which is manufactured nowhere else than in England.

Only lately has the pendulum begun to swing backward, and the authorities are naturally waiting for the expression of public opinion against the present policy of exclusion. A stable, normal condition will be reached when the equipment required for home industries is admitted freely and merchandise which is produced in France is heavily protected or even practically excluded. At the present moment this exclusion is carried so far that French industry itself is suffering greatly, but, as already explained, sentiment is changing.

In the meantime, and for several months—perhaps a year, and certainly not before peace is signed—the American exporter should expect little business from France. One of the straws which shows the change in the direction of thought here is the proposed permanent exhibit, near Passy. A syndicate of French capitalists has been formed to build a commercial center in which to house the sales offices and display rooms of both foreign and domestic manufacturers. The idea is to convince the foreign manufacturer that he should be represented in this permanent exposition; and certainly no such venture would succeed under the present restrictions as to imports. Another indicator is the fact that the owner of a large office building, which is about completed, is making it strictly modern and American, and expects to fill it, to a large extent, with American occupants. This would be impossible if the present policy were maintained.

Much has been written regarding deliberate damage done by the Germans to the manufacturing plants in the neighborhood of Lille. The machinery that was not touched, however, is in a useless condition, due to the action of the weather and the elements during the four years of war and idleness, so that all must be replaced. It is quite possible to lay too much stress on what the Boche did, and not enough on what must be done to reëstablish the industries. Many soldiers are being demobilized and many are without employment. This is so true that the hotels are able to employ waiters at $14 per month, chambermaids at $9 per month, and elevator boys at nothing per month. The majority of the hotel guests are foreigners, who do not appreciate these conditions.

A recent order for grinding machinery included 4-in. balls, but it was found impossible to purchase these in France, although one of the easiest and simplest of foundry products. It is difficult to hope for any great industrial change until after peace is signed; and one of the points which is giving great concern to the financiers is the question of exchange, and what will become of the franc when international trade is free of all restraint, except of import duties.

It seems likely that the American trader who has installed himself in France is six months to a year too early.

MARK R. LAMB.

Paris, Feb. 28, 1919.

About Spanish

The editorial in the Mar. 29 issue of the *Journal* on the Spanish language fails to include one aspect of the matter. You say: "American mining companies in Chile and Peru doubtless like to engage men with a knowledge of Spanish, but they would probably prefer those who have acquired it in the field." But how about the natives of Chile and Peru; are they not deserving of some consideration? The mining engineer who has learned Spanish in the field has usually acquired it from the *peons*, and, consequently, in his official or social intercourse with educated natives, he has no other means of communication than *peon* Spanish. To that extent he suffers in their estimation and in his own dignity. In the same way a foreign manager in this country who commanded no better English than is spoken by immigrant laborers would suffer in our estimation.

Learning the language in the field has also the drawback that the dialect of one country or district is of little value in another, whereas Castilian is understood and respected wherever Spanish or its derivatives are spoken. Like most things worth while, it is difficult to acquire, but offers a bonus on its utilitarian value as the gateway to one of the richest of literatures.

New York, Apr. 1, 1919. H. H. KNOX.

[The criticism is welcomed, and the point made by Mr. Knox is well taken. Nevertheless, we would like to dissociate ourselves from the idea that the engineer must necessarily acquire his Spanish from the laboring class—a conclusion which was neither implied nor anticipated. We said: "A new language can best be *studied* after one reaches the country where it is spoken," and such an opinion can hardly be construed as advocating the acquisition of *peon* Spanish unintelligible to the better-class native. Needless to say, we are thoroughly appreciative of and in whole-hearted agreement with Mr. Knox's closing remark.—EDITOR.]

Standardization of Salaries

The thoughtful editorial on the "Standardization of Salaries" that appeared in the *Journal* of Mar. 8 should be read by all engineers. The attempt on the part of the American Association of Engineers to evolve a schedule is commendable, and should find ready support. It is the lower-salaried men that have the greatest difficulty in securing compensation adequate to their needs and commensurate with their attainments. The very

nature of their employment, the relatively small groups that exist in any one locality, prevent the determination of anything like a standard salary for particular kinds of engineering work. The numbers of young graduates that scatter out into engineering fields each year, and who are ready to try any job at almost any salary in order to get a start, undoubtedly complicate the situation. I am also of the opinion that the low starting salaries have some influence in keeping down the salaries that as a rule are offered for more responsible positions.

Employers are to be blamed for their shortsightedness in keeping men on low salaries, for, when such men leave, the expense required for their replacement and the interruptions to the regular course of the work, not to mention the actual money loss that may result from mistakes, involve an expenditure that in the aggregate is greatly in excess of the salary increases that might have retained the men. Although the turnover is not as great as in the case of labor, it is large enough to be well deserving of consideration.

Much is heard of welfare for the working man, and there is a great deal of talk of profit-sharing for him, but nothing is said about the man in intermediate position. He is like the "common people"—presumably able to take care of himself and not supposed to raise any objection. Still, it is difficult to prevent him from making comparisons, and the conviction that there should exist an organization to further his interests will arise and persist. I am not in favor of an organization similar to the labor union, but I believe that the national societies might find this a fertile field of endeavor. Why should they not look into the problems that confront the younger members of their organizations. Why should they not stand for adequate compensation in the starting and intermediate positions? They had to struggle through the mill themselves, and are in a better position to appreciate the difficulties, and to take effective steps, than employers. METALLURGIST.

New York, Mar. 15, 1919.

Steam Economics in Simple Terms

Mr. Worcester's article, "Steam Economics in Simple Terms," which appeared in the *Journal* of Mar. 29, reminds me strikingly of a similar experience of mine. On p. 562, in speaking of hand-operated cutoffs and valves, he tells of a remarkable experience in which he made a considerable saving for a company by teaching the engine room men to use the cutoff instead of regulating the engine by means of the throttle valve, and received a substantial remuneration for so doing. The remarkable parts of the story are, first, that he was allowed to monkey with the machine at all, and, second, that he was paid anything for his trouble. Probably his boss had more confidence in him than my boss had in my ability.

Immediately after being graduated from college I worked at a mine in Colorado where there was a steam-driven air compressor which had a hand-operated cutoff valve. For some reason I was chosen as the man to run this compressor during the night shift. The reason for this strange choice could not have been because I was a licensed steam engineer, for no one there knew I had ever held such a license. Whether it was because they thought the job required no particular knowledge, or for the reason that no one else cared for a 12-hour night job all alone in the power house, I never knew.

The former engineer, who had operated the plant for many years, showed me all the intricacies of the machine and the job for a couple of shifts, until I was considered sufficiently informed to assume the great responsibility alone. The cutoff valve was set at one-half, and should never be touched, according to instructions. However, as soon as I was alone, I opened the throttle valve wide, carried a full 100 lb. of steam, and regulated the compressor by means of the cutoff valve, which saved me some labor in the way of firing the boiler. Next morning the old engineer came in unexpectedly and caught me in the act of regulating this valve. Words can hardly describe his horror and indignation that I should touch that sacred part of the mechanism. I would have something smashed, and might easily blow up the plant, if I did not follow instructions. Words from me only added fuel to the fire, and I was threatened with discharge. Later I had an opportunity of taking this question up with the manager, but he felt that I should continue to run the engine as it had always been run. Still later I explained the case to the master mechanic as lucidly as I could and in as many ways as I could think of. He was willing to admit that perhaps I might be correct theoretically, but practically they had found it best to leave the cutoff at one-half and regulate the machine by means of the throttle. It had always been done that way, and something might happen if I started to do differently. They all agreed that I would be fired should I persist. Consequently I had to use the throttle valve until all visitors had retired, and be sure that the cutoff was left at one-half when I went off shift.

Evidently the wise heads had some consultations on this point, for the old engineer later said in way of apology, "I suppose you fellers do learn a lot of things back East. I don't know as it would do any particular harm to move that there wheel, only we never do."

Dover, N. J., Apr. 16, 1919. A. O. CHRISTENSEN.

Calibration of Base-Metal Thermocouples

In the Mar. 22 issue of the *Journal* I note a letter from Prof. W. F. Dietrich, of Stanford University, in regard to an article of mine on the "Calibration of Mar. 8. I agree with Professor Dietrich that a of Base-Metal Thermocouples," published in the *Journal* correction factor must be applied to the cold-junction temperature of the rare-metal couple, as indicated, and this was done in the case of the sample calculation given, but mention was inadvertently omitted. That is, the temperature of 16.8° C., as given, was the corrected temperature, the factor used being 0.55, which is the correction factor for the particular couple used, in the range 650° to 1000° Centigrade.

The factor in the case of the base-metal couples was purposely neglected, because I consider it an ultra refinement when the normal errors in practice are taken into consideration.

I am aware of the fact that couples calibrated at one temperature may not hold the same calibration factor for another, but I think that my statement that the correction to be applied to the base-metal couple (10° F.) is correct. I had previously stated that it was desired to control the temperature within the range of about 1000° to 1600° F. It was also mentioned that the couple was calibrated within this range.

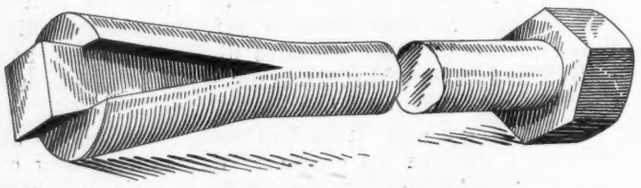
I agree with Professor Dietrich that I have carried my figures to more decimal places than necessary, and I would not do so in practice. It was done in the sample calculation merely to show the steps in detail.

One additional correction should be made at this time, also. The article read that I used one couple of Pt and one of Pt-Rh, whereas it should have read that there were two Pt + Pt-Rh couples used.

C. S. CROUSE,
Professor of Metallurgy, University of Kentucky,
Lexington, Ky., Apr. 2, 1919.

Setting Anchor Bolts With Sulphur

The description of grouting an engine bed with sulphur that appeared in the *Journal* of Feb. 8 suggests another similar use of sulphur at mine power plants, i.e., that of setting an engine or hoist on an old foundation which has no appropriate anchor bolts. To do this, anchor bolts are prepared as usual, excepting that the bottom end is split but not opened out. Iron wedges are then made and driven into the split, just far enough to secure a firm hold. Holes are drilled in the foundation large enough to allow the bolt to go in easily. The bolt is inserted, and after the nut is placed in position to protect the threads, the bolt is driven down on the



METHOD OF PREPARING ANCHOR BOLTS

wedge, which forces the wings apart, as shown in the sketch. Molten sulphur is then poured in around the bolt, and in half an hour is set hard enough to hold the machinery in place.

A man-hoist at the Esperanza mine at El Oro, Mexico, that handles triple-deck cages with 27 men per trip, has been anchored in place for over eight years by means of bolts set in this manner, with no sign of loosening yet. As noted in the article on grouting mentioned above, care must be taken in melting the sulphur not to overheat it.

FREDERICK MACCOY.
Jerome, Ariz., Feb, 15. 1919.

Improved Mexican Conditions

We noted with much interest the article appearing in the Mar. 22 issue of the *Journal*, by "American Engineer," and believe the closing paragraph summarizes the Mexican conditions better than any other article we have seen on the subject.

Operations on our properties in Mexico were suspended in 1914, but we have managed to protect the titles, and have recently succeeded in rebuilding the El Favor-Mololoa mill. Operations were started on Feb. 22. Only 15 of the 35 stamps are in operation, but the remainder of the mill will be completed at an early date. Shipments of high-grade ore were being made to the smelter while reconstruction was going on, and, altogether, 22 cars have been sent out.

The cost of marketing this ore is, of course, high under existing conditions, but at the present price of silver the transaction leaves us a satisfactory margin of profit. A number of our stockholders recently made a trip of inspection to the properties. The party was given special consideration and attention all through the country. It entered by the Port of Laredo, going through Mexico City, where a stop was made, and thence to Guadalajara, and made side trips out on the National lines and the Southern Pacific to our different properties. The return was over the same route. The party has traveled over Mexico for two weeks, both by train and mule, without accident or difficulty.

MAKEEVER BROTHERS.
New York, Mar. 28, 1919.

Concerning Ricketts & Co., Inc.

Our attention has been called to an article on p. 542 of the Mar. 22 issue of the *Journal* headed "Dr. A. R. Ledoux." A sentence in this article reads as follows: "After the partnership with the late Dr. P. de P. Ricketts was dissolved, Dr. Ledoux continued to carry out professional work in the same office, the name of the firm being changed from Ledoux & Ricketts to A. R. Ledoux & Co." This is considered by our clients to indicate that, owing to the death of Dr. Ricketts, the firm of Ledoux & Ricketts dissolved, and that this dissolution happened only recently.

As a matter of accuracy, Dr. P. de P. Ricketts and Dr. A. R. Ledoux formed a limited partnership in the year 1881, which was to last for five years. At the expiration of this time, namely in 1886, the firm of Ledoux & Ricketts was dissolved by mutual consent, and the two firms of A. R. Ledoux & Co. and Ricketts & Banks were formed. The firm of Ricketts & Banks was later dissolved, and the firm of Ricketts & Co., Inc., was formed and we have been carrying on our professional work for a number of years, and still are carrying it on, with a greatly enlarged laboratory and staff. Our offices are at 280 Madison Ave. and our laboratories are at 7 Dutch Street.

RICKETTS & CO., INC.
New York, Apr. 3, 1919.

Ball Milling and Flotation

It would appear, from the letter published in the Mar. 8 issue of the *Journal*, that the writer, A. P. Watt, is unacquainted with the facts as to the operation of the Marcy mill at the experimental plant at Inspiration. To be correct, it was first used as an intermediate machine, but at the time of the carrying out of the flotation work under consideration it was producing a finished product.

I differ from Mr. Watt in his conclusion that the size of the sulphide particles in the overflow of the ball-mill product is determined by the classifier alone. Classifier capacity is of great importance in lessening the amount of overground material; but in overflow mills the sulphide particles show the same amount of overgrinding as the gangue particles, no matter what the classifier capacity is. This overgrinding does not affect the saving to any extent in flotation, but is a disadvantage in water concentration. In cyanidation, where the metals are, for the most part, contained in the sulphides, the overgrinding of the sulphide particles is, naturally, of considerable benefit.

C. T. VAN WINKLE.
Salt Lake City, Utah, Mar. 29, 1919.

Assayer and Chemist

New methods of analysis and experimental control are evolved from day to day; and the helpful influence of fresh ideas and old but pertinent facts clothed in new language or presented from a new point of view cannot be overestimated. A number of notes are appended dealing with a variety of subjects of interest to those engaged in laboratory work; but many other ideas fail to bring credit to their sponsors and do not achieve the broader purpose of successful experimentation for lack of publicity. Hidden lights are futile. The value of an effort can be estimated only after it has been made. The compilation of even a short note on a point of interest may open up avenues of thought and research, leading to further investigation and achievement. The intention to publish either facts or opinions should result in introspection and the cultivation of a greater degree of accuracy. No achievement is self-sufficing—it must inevitably fade in importance and be replaced by a desire toward a greater and more serious effort.

Analysis of Graphite Ores*

A sample, weighing 0.2000 to 1.0000 gm., depending on the relative amount of graphitic carbon present, is placed in a 100-c.c. evaporating dish with 25 c.c. of 1 to 1 HCl, heated over a hot plate for 15 min., filtered through a filter of ignited asbestos, and washed with hot water until free from chlorides. The filter and the residue are then transferred to a porcelain or platinum boat and dried on the hot plate. The boat containing the residue is transferred to the tube of a combustion furnace and burned in a stream of oxygen gas, the CO_2 formed being collected in a potash bulb with a 30% KOH solution. The combustion tube should contain some fused lead chromate to retain any sulphur that may be present.

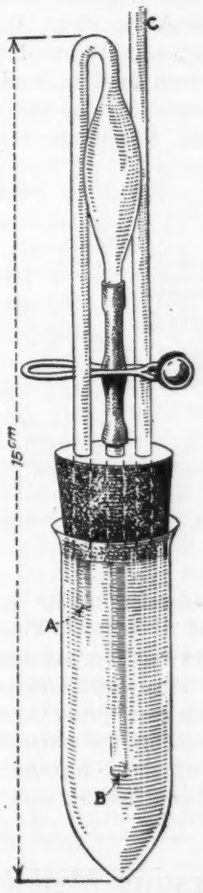
Rapid Carbon Dioxide Determination

BY A. GRAIG†

Having occasion to test for small amounts of carbonate in factory control work, I found the apparatus to be described convenient, and the results obtained were fairly accurate for low percentages.

The generator shown in the sketch is made of a test tube shortened to a convenient length. The pipette bulb may be made by blowing out a piece of thick-walled tubing of small diameter to a capacity of about 2 c.c. The tube *A* extends below the stopper just far enough to connect a rubber tube. The tube *B* is made long enough to dip into a small beaker for filling. *B* and the pipette are connected by a rubber tube and pinch-cock, so that air from the generator replaces the acid falling from the pipette. *C* leads to the gas burette, for which I use two ordinary 50-c.c. burettes. *C* is continued in one piece, turned across and down, and stoppered into the top of one of the burettes, so that the generator hangs from it without other support, but is sufficiently flexible to allow of being shaken.

To fill the pipette, attach a rubber tube to *A* and suck the acid up through *B*. Concentrated HCl is best, as CO_2 is not appreciably soluble in the small amount used. Then, as a standard, weigh 0.2 gm. of ignited



APPARATUS FOR DETERMINING CO_2

Na_2CO_3 into the dry test tube. A 50-c.c. graduate makes a convenient holder. Fill the open burette and raise it in the hand until the water rises to the "0" of the closed burette, leaving enough in the open burette for leveling. Close the stop-cock of one of the burettes, return the open burette to its stand, connect the generator, level, and read the burette, taking care not to allow the hands or breath to warm the inclosed air. Then open the pinch-cock of the generator, allowing the acid to fall drop by drop until the action ceases. Shake the generator by the pinch-cock to make sure that the acid has reached all the carbonate. Then level the burette and read it, taking the increase in volume

*Abstracted from pamphlet No. 3 of the War-Minerals Investigation Series, U. S. Bureau of Mines, by George D. Dub.
†American Reclaiming and Refining Co., Jersey City, N. J.

as CO_2. The volume of gas will be about 47 c.c., as under room conditions gases have almost exactly 90% of their standard weight. This is true, of course, only near sea level. The tests should then be made at once, without allowing the temperature of the room to change. Greater accuracy may be obtained, particularly when caustic alkalies are tested, if the generator is immersed in water at room temperature during the reaction and the reading of the burette, though time is saved if the heat developed is so small as to be negligible and this precaution is omitted. The result may be calculated by means of the following factors: 0.0830 ÷ c.c. of standard reading × c.c. of test reading = grams CO_2 in test.

Nomenclature of Sodium Compounds*

By Roger C. Wells

The name soda was originally used for the basic part of sodium compounds to mean the oxide, Na_2O, the name being analogous to those of other oxides. However, it has long been used in trade for the carbonate and in household economy for the bicarbonate and the hydrated carbonate, known as sal soda, and is frequently applied indiscriminately to all compounds of sodium as "nitrate of soda." The better usage is to call such substances "sodium" compounds—for instance "sodium nitrate"—to prevent ambiguity.

The accompanying table gives the various trade names, the chemical formula of the important constituent, the usual percentage of the compound designated in the marketed product, and the ordinary chemical name.

TRADE NAMES AND FORMULAE OF SODIUM COMPOUNDS

Trade Name	Formula	Percentage	Chemical Name
Soda ash	Na_2CO_3	98-100 Na_2CO_3	Sodium carbonate.
Sodium carbonate monohydrate	$Na_2CO_3 . H_2O$	85-86 Na_2CO_3	Sodium carbonate monohydrate.
Sodium sesquicarbonate, trona	$Na_2CO_3 . NaHCO_3 . 2H_2O$	47 Na_2CO_3. 37 $NaHCO_3$	Hydrated sodium carbonate-sodium bicarbonate.
Sal soda, washing soda, crystal carbonate	$Na_2CO_3 . 10H_2O$	37.1 Na_2CO_3	Hydrated sodium carbonate.
Bicarbonate of soda, baking soda, saleratus	$NaHCO_3$	99.3 $NaHCO_3$	Sodium bicarbonate or acid sodium carbonate.
Caustic soda	NaOH	75-99 NaOH	Sodium hydroxide.
Soda lime	NaOH+CaO		Sodium hydroxide and calcium oxide.
Borax, Tincal	$Na_2B_4O_7 . 10H_2O$	52.9 $Na_2B_4O_7$	Sodium tetraborate.
Sodium hyposulphite, "Hypo."	$Na_2S_2O_3 . 5H_2O$	64$Na_2S_2O_3$	Sodium thiosulphate.
Yellow prussiate of soda	$Na_4Fe(CN)_6$	100 $Na_4Fe(CN)_6$	Sodium ferrocyanide.
Red prussiate of soda	$Na_3Fe(CN)_6$	100 $Na_3Fe(CN)_6$	Sodium ferricyanide.
Sodium nitroprusside	$Na_2Fe(CN)_5NO . 2H_2O$	88 $Na_2Fe(CN)_5NO$	Sodium nitroprusside.
Salt cake	Na_2SO_4	98-100 Na_2SO_4	Sodium sulphate.
Niter cake	$NaHSO_4$	78 $NaHSO_4$	Sodium bisulphate or sodium acid sulphate.
Glauber's salt	$Na_2SO_4 . 10H_2O$	44.1 Na_2SO_4	Hydrated sodium sulphate.
Chile saltpeter, Soda niter	$NaNO_3$	95-96 $NaNO_3$	Sodium nitrate.

Separating Mixed Oils†

By Paul W. Prather

As is well known to anyone who has to make a separation of mineral and saponifiable oils, one of the most troublesome conditions is the formation of an emulsion after shaking the soap solution with ether in a separatory funnel. The emulsion can be rapidly destroyed by the simple procedure of applying the hose of a good suction pump to the mouth of the funnel. In a few seconds the ether will boil and the emulsion disappears, leaving a sharp line of demarcation between the ethereal layer and the aqueous solution. If a piece of heavy-walled rubber tubing is used, of ⅝-in. outside diameter, so-called nitrometer tubing, a tight joint can be made by merely inserting the end in the funnel mouth.

Estimation of Cyanogen in Cyanide*

By Roger C. Wells

Analysts are accustomed to determine only the cyanide radical in cyanides, as their value depends on the cyanogen content, but it has long been customary to report the cyanogen as potassium cyanide. As pure potassium cyanide contains 40% and sodium cyanide 53% of cyanogen, it follows that sodium cyanide may be reported as carrying more than 100% of potassium cyanide. This also allows very impure sodium cyanide to be sold as 97 or 98% potassium cyanide, but, needless to say, the potassium salt is not now largely used. Recently sodium cyanide has been selling on the basis of its actual sodium-cyanide content, the highest grade being 96 to 98% sodium cyanide (NaCN); or cyanogen 51 to 52%. The old "98% KCN" carried about 39% of cyanogen. Four pounds of sodium cyanide are therefore chemically equivalent as a solvent to about 5lb. of the old "KCN."

Parting Gold-Silver Prills

By D. E. Charlton

The process to be described suggests a method which may be used in heating the porcelain crucibles containing the parting solution; and, where adopted, has resulted in a saving of heat and the elimination of unnecessary paraphernalia:

After "blicking" has occurred, the cupels are removed from the muffle, placed in the same relative position on an asbestos-covered board, and the buttons removed. The buttons are then brushed, weighed, and flattened if necessary, and dropped into the crucibles for parting. The latter are placed on the now partly cooled cupels, each button occupying its original cupel. Provided there are not too many buttons to be weighed, it will be found that sufficient heat is retained in each cupel to complete the parting, and the acid solution will not boil over unless the crucibles are placed in the cupels too soon after their removal from the muffle, or unless only a small amount of acid is used. The same method may be adopted for drying the prill, after the parting solution has been poured off and the gold washed, previous to brightening.

*Abstracted from "Mineral Resources of the U. S., 1917—II," p. 307.

†Abstracted from *Chemist-Analyst.*

*Excerpt from "Mineral Resources of the U. S., 1917—II," p. 326

Company Reports

New Cornelia Copper Co.

In the annual report of the New Cornelia Copper Co., L. D. Ricketts states that during 1918 the production of copper was as follows: Electrolytic cathodes, 31,264,642 lb.; returnable copper in cement copper shipped, 10,990,666 lb.; returnable copper in ore shipped, 4,694,831 lb.; makng a total of 46,950,139 lb.

Toward the end of the year a small amount of diamond drilling was authorized to the southwest of the developed orebody to determine the proper limit for stripping in the open-pit operations, and this development work has already opened up about a million tons of additional sulphide ore. A number of diamond-drill holes in the main orebody were bottomed in ore, and there is undoubtedly much ore under the developed ore which cannot be measured until further development work is done. The tonnage of completely developed ore remaining in the ground at the beginning of the year, together with tonnages that have been extracted, is shown in the following table:

ORE RESERVES OF NEW CORNELIA COPPER CO.

	Tons	Average Estimated Grade Per Cent. Cu.
Oxidized ores	11,960,145	1.568
Sulphide ores	40,302,457	1.587
Total	52,262,602	1.579
During the year the following tonnages of ores were mined:		
Oxidized ore to the leacher	1,775,000	1.465
First class ore to Douglas	84,161	3.39
Total	1,859,160	
Tonnage remaining	50,403,441	
During the year there were developed ores as follows:		
Sulphide ores	916,980	1.573
The tonnage of ore estimated as fully developed at the end of 1918, therefore, is	51,320,421	

When the Ajo Consolidated property was purchased and absorbed it became evident that a greater monthly production was justified than the total of 3,000,000 lb. originally planned, and it was found necessary to undertake certain construction which would permit increase of output and prevent overstrain. In producing 2,250,000 lb. or more of electrolytic copper it was found necessary to run all three of the motor-generator sets continuously. A fourth unit was accordingly ordered and is now being installed. A fifth unit of three Symons disk crushers has been added to the fine-crushing plant. This will permit the operation of four at a time, permit the work of crushing to be completed within 16 hours, and greatly decrease the cost of repairs and upkeep of the plant.

Two additional reduction towers for the reduction of ferric iron by sulphurous-acid gas were added to the four originally installed. These towers are of larger size and equal in capacity the four towers originally built. These towers were necessary to decrease power consumption in the electrolytic tank house and because of the larger output of copper.

It was found that washing the leached ore with four wash waters was insufficient. An additional sunken concrete tank of 500,000 gal. capacity was accordingly built, providing storage for a fifth water wash. This tank has been put in operation and has resulted in an increased saving of nearly 1 lb. of copper per ton of ore.

At the main pumping plant at Well No. 1 a new station has been cut and a pump similar to the pump now in use, but of somewhat larger capacity, is to be installed. This pump provides an adequate spare and insures a steady water supply. A small duplicate air compressor, an additional steam shovel, a locomotive, and 16 new pit cars for transporting the ore to the crushing plant have been added to the mine equipment.

In the course of two years, sulphide ores will be uncovered in the open pit. In about three years the mine can produce as much as 5000 tons a day of this class of ore; and, after that, the output should rapidly increase until a capacity of 10,000 tons a day of sulphides can be produced. The question of the proper way to treat this ore is most important. In spite of the high cost of material, therefore, an appropriation was obtained from the board of directors (of $160,000) for the construction of a test mill. It is not the intention to run this mill at the start for more than one shift a day, but it is necessary to have a mill of this size, because it must be furnished with full-sized machines in order that the results obtained may be relied upon and duplicated in the final plant. Little difficulty is expected in obtaining knowledge as to a suitable process.

There is no doubt that ores similar to those now available are easily amenable to flotation. The chief problem to be solved is the determination of the proper method of grinding the ore; the actual fineness to which it should be ground and the proper machines with which to do it. The ore is hard, and this problem is an important one. The test mill will be started sometime during the spring of 1919.

The only construction work that may be recommended during the year 1919 is a new or modified plant for the cheap handling of the cement copper. Permanent construction of a plant of this kind has been delayed in order to develop a practicable process. This has apparently been done; and, with a proper system of tanks and the introduction of mechanical handling of cement copper, costs can undoubtedly be reduced and expenditures abundantly justified.

Calumet & Arizona Mining Co.

In the annual report of the Calumet & Arizona Mining Co., L. D. Ricketts stated that during the year there was produced at the company's smeltery 83,442,625 lb. of fine copper, of which 49,432,984 lb. was the product of the Calumet & Arizona Mining Co. and the remainder was produced from New Cornelia and other custom ores. The smeltery also produced 32,682.35 oz. of gold, and 1,109,411.50 oz. of silver.

In addition, 60,733 tons of sulphide ore returned 1,848,568 lb. of fine copper, 2,107.524 oz. of gold, and 56,069.37 oz. of silver.

The supply of labor throughout the year has been inadequate. The average number of men employed

underground prior to June, 1917, was about 1450, with a surplus of miners; whereas during the year 1918 the average was about 1140, with no surplus. With this scarcity of labor there was a marked decrease in efficiency, which is estimated to have been fully 30% less than when the labor supply has been abundant.

The most important development work undertaken, aside from that in connection with the known orebodies, was in the long drifts on the 1400 and 1600 levels, to develop the territory adjacent to the recent developments in the Denn mine. These developments are important because they are at least 2000 ft. from any of the known orebodies, in entirely new territory. This ground is regarded as most promising for the development of important orebodies.

The Campbell shaft was closed down in 1917, on account of the scarcity of labor, and work in the sinking of this shaft to the 2000-ft. level ceased.

The reports of the engineers show that the company has somewhat increased the tonnage of ore in sight during the year. The war closed so near the end of the year that there has been no visible effect on costs or wages, but there is no doubt that the result will be a reduction in wages and a decided increase in the efficiency of the men.

The smeltery has worked continuously, with a decided falling off in tonnage of custom ore as well as of domestic ore. As the ore is mined from deeper levels there is less and less oxidized ore and more sulphide, and it is becoming evident that it will be more advantageous to smelt all the ore in reverberatory furnaces if it be possible to solve the problem of crushing the lump ore cheaply and expeditiously, because the company will be able to obtain lower ton costs and better recoveries. This subject is receiving serious consideration.

The new 3000-kw. turbine operated satisfactorily during the year. The transmission line has been strengthened, and heavier transmission wires have been installed. In spite of some delays and a close-down for a considerable time to replace transmission wires, a continuous average of over 1000 kw. of electric power produced from steam generated from the waste heat from the reverberatories has been sent to the mine. At the present time it is not practicable to consider the expansion of the power plant, on account of slow deliveries and high costs, but there is no doubt that at as early a date as practicable the company should add at least one more 3000-kw. turbine and furnish more power to the mines. In the course of the next year this will become an important question, because either the power plant at the smeltery will have to be increased, or the power plant at the mines, which is antiquated, must be replaced. The power plant should be centralized at Douglas as far as possible.

Shattuck Arizona Copper Co.

The Shattuck Arizona Copper Co. reports a gross income for the year ended Dec. 31, 1918, of $2,663,082.83. Subtracting costs amounting to $1,883,424.04, which include expense of development work, refining and marketing of metals and general administrative disbursements, the net income is $784,658.79. Reservations for depletion of mine and depreciation of plants and equipment are placed at $541,191.47, and, deducting this sum from the net income, there is left a net profit for the year of $243,467.32. Dividends paid amounted to $437,500. Adding the net profit to the balance on hand Dec. 31, 1917, and deducting dividends, a balance, as of Dec. 31, 1918, of $809,095.83 remains.

During 1918, the report shows that 93,967 tons of copper ore and 29,277 tons of lead ore were mined; 93,995 tons of copper ore and 29,106 tons lead ore were shipped, and 94,092 tons of copper ore and 28,550 tons of lead ore were smelted and treated. Development work done during 1918 was about the same as in 1917, and totaled 15,125 ft., the work being distributed on nine levels. The milling plant for low-grade lead ores began operation on July 1, 1918.

Osceola Consolidated Mining Co.

Total copper produced during 1918 by the Osceola Consolidated Mining Co. amounted to 15,919,647 lb. at a cost of 17.67c. per lb. For 16,380,996 lb. of copper delivered, an average of 24.41c. per lb. was received. Total net income from 1918 operations was $1,203,953,42; taxes were $660,882.44 (estimated) and dividends paid amounted to $961,500. Rock treated amounted to 1,194,967 tons, at a cost, including mining, transportation, stamping and taxes, of $1.78 per ton. Refined copper per ton of rock treated was 13.3 lb. Underground work during 1918 consisted of the following: Osceola, No. 6 shaft, 1219 ft. of openings; North Kearsarge No. 3 shaft, 122 ft. of openings, and No. 4 shaft, 379 ft. of openings.

Mass Consolidated Mining Co.

The Mass Consolidated Mining Co. reports for the year ended Dec. 1, 1918, that its income was $796,638.33 and expenditures were $810,967.81. Additions to buildings and equipment cost $13,703.50; insurance and real estate sales amounted to $2434.16. Together with the balance on hand Jan. 1, 1918, total cash assets, as of Dec. 31, 1918, were $295,773.01. Scarcity of labor hampered operations and increased costs. Development work totaled 1945 ft. of drifting and 337 ft. of crosscutting. A total of 196,456 tons of rock was stamped, and produced 5,509,130 lb. of mineral. This amount gave a total refined copper production of 3,403,827 lb. at a cost of 23.82c. per pound.

Colorado Fuel and Iron Co.

The 27th annual report of the Colorado Fuel and Iron Co. states that gross receipts from sales during 1918 totaled $48,233,574.51; operating expenses were $40,769,206.12, and net earnings, $7,464,368.39. Other items are: Income from sources other than operation, $636,742.26; interest, taxes, sinking funds, and similar charges, $2,781,088.83; depletion, depreciation, and value reductions, $2,187,974.08; estimated amount of income and excess profits taxes, $400,000, and dividends, (8% on preferred and 3% on common stock), $1,186,875.40. After making the proper additions and deductions, $1,545,172.34 remains as a credit to profit and loss.

The sum of $607,862.99 was spent for additional tenant houses and club houses for employees; three increases in wage rates were made during the year, and an eight-hour day was established at the steel plant. The report shows that 809,491 tons of iron ore and 4,455,881 tons of coal were mined; 452,986 tons of limestone quarried; 432,406 tons of pig iron produced, and 800,638 tons of coke manufactured. Finished iron and steel production amounted to 478,916 tons.

The Industrial Conference

THE Editorial Conference of the New York Publishers' Association held an important symposium on industrial and economic conditions on Apr. 11 in New York. Much credit is due to the executive committee of the conference for the careful preparation of an interesting and important program.

The subjects and speakers were: "Recent Advances in Industrial Management," by John Calder; "Problems of Our Foreign Trade," by G. A. O'Reilly, of the Irving National Bank; "Necessity for Organization in the Settlement of Labor Disputes," by V. Everit Macy, president of the National Civic Federation; "Industrial Democracy," by Dr. Charles A. Eaton; "Post-War Financial Problems," by Francis H. Sisson, vice-president of the Guaranty Trust Co.; "Prices, Yesterday, Today, and Tomorrow," by O. P. Austin, chief statistician of the National City Bank, New York; "Industrial Coöperation," by Charles P. Steinmetz, consulting engineer of the General Electric Co.; "Stabilizing the Dollar in Purchasing Power," by Professor Irving Fisher, of Yale University.

Though all of the papers were of considerable interest, space is not available for extended comment, and extracts are given from two of the papers only.

From the address of Francis H. Sisson, the following significant paragraphs are taken:

"We gradually are comprehending, also, that whether or not there shall be a formal organization of a League of Nations, we are bound to other peoples by innumerable and far stronger ties than those which any international covenant could impose. There has, indeed, been no more convincing proof of this fact than that recently provided by the withdrawing of governmental support from sterling and franc exchange. The larger significance of what was seemingly only a financial operation is daily becoming more apparent. It marks in a dramatic fashion the shifting from a war to a peace basis, not alone in financing, but also in practically every economic phase of international relations.

"It is one of the most immediate vital post-war financial problems, and concerns the importer and manufacturer of domestically consumed products as well as the exporter and manufacturer of goods which are sent abroad—for it creates an invisible tariff against American goods in England and France, which sooner or later, but inevitably, will affect our domestic trade. We are awakening to a realization that the prosperity of the country today depends upon increased production and, consequently, that it behooves us to expand our foreign markets instead of letting them contract.

"If we are to increase our production, which, as I have pointed out, is necessary to the maintenance of our prosperity, we cannot take goods in full exchange for our products. Besides, we are nearer than any other people to economic independence, and do not need imports in anything like the quantities necessary to settle the trade balance in our favor

"Payment in gold is as impossible as it is undesirable. The value of the excess of our imports over our exports in January alone exceeded the total value of gold produced in all countries except the United States during 1918. In addition, we now hold more than one-third of the world's reserve of gold coin and bullion, having added about $1,500,000,000 to our store of the precious metal in the last four years. We could not with safety drain other nations of their remaining low stock of gold if we would, for, as we are already their creditors to the extent of about $12,000,000,000, it is imperative for us to help them maintain their currency on as sound a foundation as is practicable under existing circumstances.

"The granting of credits to purchasers of our goods will very materially aid in solving the immediate problem of financing foreign trade, but at best it can be only a temporary expedient. Credit, as you are well aware, is merely the giving of a present value in exchange for a promise to pay. It serves to postpone payment of indebtedness to a more propitious time for the buyer or borrower, but it does not settle the account."

The address of O. P. Austin, on "Prices, Yesterday, Today, and Tomorrow," was particularly interesting and is summarized in the following:

"The chief causes of the world advance in prices appear to be the inflation of world currency, coupled with the 'scarcity demand' and the consequent advance in labor costs. The prospect of material reductions in the near future would depend upon the possibility of the removal or modification of the chief causes of the advance.

"Stated chronologically, the chief causes of the advance seem to have been first, the 'scarcity demand' for war materials, food, clothing, manufactures, and manufacturing materials and the labor required for their prompt production; but this was quickly followed by an enormous world inflation, in which paper money with a face value of $36,000,000,000 was emitted by the printing presses of the countries at war, and the legal tender circulating medium of the world was thus advanced from $15,000,000,000 in 1913 to over $45,000,000,000 in 1918, most of the gold formerly in circulation passing into the vaults of the governments and their great banks as a partial basis for this greatly enlarged paper currency.

"The enormous inflation thus brought about, coupled with the continued 'scarcity demand' for food, manufactures, manufacturing material, and labor required for their production, was accompanied by great advances in prices, first in the materials for the war, the advances gradually extending to other articles which their respective producers must exchange for those in which the advance had already occurred, and this made the advance in prices worldwide, and applied to all classes of articles, irrespective of their immediate relation to the requirements of the war.

"The chief question involved in a consideration of the future of prices is whether there is a prospect of an early removal of the causes of the advance. The 'scarcity demand' still continues in everything except war supplies, and even in that line is not entirely ended, as there are about 15,000,000 men still under arms. The demand for food is as insistent as ever, owing to the disordered state of the population of Central Europe and the impoverished condition of the neglected soils of all that Continent, and the factories and empty shelves of all the world are clamoring for new supplies, which

ran low, during the long extended war period.

"As to a material reduction of the inflated currency, the prospects for the near future do not seem encouraging, in view of the fact that the 1919-20 'budgets' of the principal countries of the world, now being made up, call for fully four times as much money as those of the year preceding the war, suggesting that the governmental demands in the first peace year after the war will be about $50,000,000,000, as against about $12,000,000,000 in 1913, and that the governments which must quadruple their demands upon their taxpayers and prepare for a reduction of their debts will hesitate about reducing the amount of money in circulation.

"Though there may be a slight downward trend in the general price level, and distinct reductions in certain articles, the difficulty in removing the chief causes of the advance suggests that the general reduction in prices in the near future may not be as rapid as had been anticipated."

South Dakota's 1917 Gold Production*

The output of gold from mines of South Dakota during 1917 was 356,244.88 oz., valued at $7,364,233. The decrease in the output for the year was 4,663.88 oz. in quantity, and $96,411 in value. The output of placer gold was 44.70 oz. There were 30 producing mines, of which 23 were deep and 7 were placer, a decrease of 6 deep and 9 placer mines as compared with 1916.

The total quantity of ore mined and treated in 1917 was 1,868,310 short tons, averaging in recovered gold 0.1907 oz., or $3.94 per ton, as compared with 1,870,783 short tons, averaging $3.99 per ton, in 1916. The mills of the state treated 1,867,583 tons of ore, which yielded as bullion $7,350,460 in gold and 181,051 oz. of silver, valued at $149,186, an average recovery per ton of $3.94 in gold and 0.10 oz. silver, as compared with $3.98 in gold and 0.11 oz. in silver in 1916. The crude ore shipped to smelteries amounted to 727 tons, having an average content per ton of 0.855 oz. of gold, valued at $17.67, and of 7.85 oz in silver.

GOLD PRODUCED AT MILLS IN SOUTH DAKOTA IN 1917

Process	Ore Treated, Short Tons	Gold in Bullion, Fine Ounces
Amalgamation	1,677,623	228,018.51
Cyanidation	(a) 1,809,417	127,560.01
Total		355,578.52

(a) Includes 1,619,457 tons of tailings from part of ore amalgamated.

In 1917 the mines in South Dakota consumed 13,199 lb. of quicksilver and 384,938 lb. of sodium cyanide, equivalent to 1 lb. of quicksilver, for every 17.28 oz. of gold, or every 127 tons of ore treated, 0.21 lb. of sodium cyanide for every ton of ore or tailings treated, and 1 lb. of cyanide for each 0.33 oz. of gold recovered.

The Homestake mines and mills were operated without interruption. The shaft on the Oro Hondo mine, adjoining the Homestake property, was sunk from 2000 ft. to 2200 ft., and considerable drilling and diamond drilling were done. The Golden Reward mill was operated steadily on siliceous ores obtained from its own mines. The Mogul mill was operated steadily, chiefly on custom ore. The Trojan mill was operated continuously on company and custom ore. The Bismarck mine and mill were operated for a short period. The Wasp No. 2 Co. did not operate its mine or mill during 1917, and the mill has been dismantled. The New Reliance mine and mill were idle. The Deadwood-Standard mill was operated on ore from the Elk Mountain mines during part of the year.

A small output of placer gold was made in Lawrence and Pennington counties. Small shipments of gold ore were made from the Keystone district.

*Abstracted from a Mines Report, by Charles W. Henderson, to form a section of "Mineral Resources of the U. S., 1917—Part I," U. S. Geological Survey.

The Victory Loan Cannot Fail

We have built a great arch across the world. Into it have gone the traditions and the hopes of the American people. Men and munitions and billions in gold are parts of it; the blood-cemented friendship of the civilized nations of the world is in it, and the world's future rests upon it.

Only the keystone of the arch remains to be put in place, finishing the task and binding the whole together.

That keystone in the Victory Loan.

What if we fail to raise it in triumph?

First, and most impossible, such a failure would mean the repudiation of the men who have died for us, our own men. It would mean ingratitude and an unequaled hypocrisy.

Second, such a failure would mean the disruption of our industries, and, as we and our Allies are interdependent, their industries as well.

With one accord, the business of America turned from its accustomed channels to the winning of the war. Billions of dollars were spent by the Government, and many bills remain unpaid, for work done and for goods delivered. Until these bills are paid the creditors will be crippled. The Victory Loan will pay them.

It is argued that if the Loan fails, the money can be raised by taxes. But taxes cannot be collected from a business that, for lack of money, is inactive. Taxes will not solve the problem.

The Allies owe us more than ten billions of dollars. Why not call these loans? Common decency forbids hitting a man when he is down; and the Allies are down, financially. The war has swept their treasuries bare, and two of them are sorely hurt. Consider France, with her five richest departments devastated; Belgium, overrun and ruined; England, strained to the breaking point. They need every penny we have loaned them for the rehabilitation of their own industries. If we demanded payment from them now, we should not only prevent the resumption of that production that will pay their debts, but we should make it impossible for them to buy from us, and so further hobble our own trade at a time when we need it most. We cannot ask the Allies for repayment now.

If the Victory Loan fails, the arch falls, for no arch can endure without its keystone. No heavier than the rest—no larger—it is the heart of the great structure we have raised.

If the Victory Loan fails, our country might plunge into an economic chaos, and, because our country is the richest and strongest of all, the rest of the world, harried and war-worn as we are not, might be carried with us.

Daily Production of Cartridges at one of the large plants of the Remington Arms-Union Metallic Cartridge Co., at Bridgeport, Conn., at the peak of the productive period consumed 40 tons of lead, 17 tons of powder, 59 tons of copper, 22 tons of zinc and 2 tons of nickel, according to the "New York Tribune."

Industrial News from Washington

By Paul Wooton, Special Correspondent

Exports of Mining Machinery

The exports of mining machinery from the United States during January, 1919, were as follows:

Countries	Oil-Well Machinery	All Other Mining Machinery
France	.....	$7,510
Italy	.....	8,793
Norway	$158	67,250
Spain	.....	36,641
England	500	36,874
British Honduras	.....	75
Canada	6,442	142,639
Costa Rica	.....	3,497
Guatemala	.....	2,591
Honduras	58	2,788
Nicaragua	.....	85
Panama	.....	133
Salvador	.....	980
Mexico	11,064	112,224
Newfoundland and Labrador	.....	775
Trinidad and Tobago	28,741	.....
Cuba	17,135	24,013
Dominican Republic	15,605	987
Argentina	5,231	2,278
Bolivia	.....	16,773
Brazil	1,933	4,896
Chile	.....	64,852
Colombia	277	4,349
Dutch Guiana	.....	2,182
Peru	3,746	44,502
Uruguay	54	.....
Venezuela	293	.....
China	.....	13,602
Chosen	.....	2,685
British India	568	9,719
Straits Settlements	.....	3,760
Dutch East Indies	13,299	5,511
Japan	.....	28,585
Australia	1,374	58,181
Philippine Islands	.....	20,367
Belgian Congo	.....	40,587
British South Africa	.....	157,788
Portuguese Africa	.....	28,402
Totals	$106,478	$956,874

Award to Edward R. Stettinius

General Pershing's citation in awarding the Distinguished Service Medal to Edward R. Stettinius reads as follows:

For exceptionally meritorious and distinguished services. As member and chairman of the Advisory Liquidation Board of the A. E. F., he had a guiding influence in the determination of important Army policies. He gave useful coöperation and suggestions in connection with the establishment of the finance section of the General Staff, formed to coördinate the business and financial interests of the Army. With conspicuous ability he assisted in outlining the plans for inter-Allied and international settlements of great magnitude. His assistance to the A. E. F. in varied and important matters was invaluable.

Resumption of Trade With Austria

Acting concurrently with the authorities of the other associated governments, the War Trade Board announces that persons in the United States are permitted, on and after Apr. 2, 1919, subject to the rules and regulations of the War Trade Board, to trade and communicate freely with persons in German-Austria.

In accordance with this authorization, applications will now be considered for licenses to export or import all commodities to consignees or from consignors, except that, for military reasons, the importation into German Austria of a number of commodities will be restricted, and export licenses for the same will be granted only in exceptional cases.

American exporters are advised that merchandise is permitted to be exported to German Austria only upon the understanding that it is intended to supply the internal domestic needs of that country; and that, without the consent of the Inter-Allied Trade Committee at Vienna, the reëxportation of such merchandise from German Austria to countries with which commercial relations are not authorized is forbidden. Further, such reëxportation constitutes a violation of the Trading With the Enemy Act.

For the exportation of commodities to German Austria, applications should be filed on Form X-A. No supplemental information sheet will be required, unless the commodity is a manufacture of gold, in which case Supplemental Information Sheet X-29 should be attached. For importations into the United States from German Austria, individual import licenses will be required, in accordance with the regulations applicable to imports from neutral European countries.

The War Trade Board has received no official advices concerning the regulations governing importations into German Austria, and prospective exporters should therefore communicate with their customers abroad before making definite commitments, so that the importers may comply with any import regulations that may be in effect.

Postal communications should be addressed via France or Italy or Switzerland, and sent either on French or Italian licensed liners carrying mail. Cablegrams and cable remittances should be made via French cable lines. Merchandise should be shipped on vessels proceeding directly to Adriatic ports, preferably Trieste.

British Import Restrictions

The War Trade Board announced, for the information of exporters in the United States, that it has been informed of the following changes in the import regulations of Great Britain:

The following commodities, which heretofore have been importable only under special license, are now among a number which may be imported freely under general license: Abrasives, abrasive cloths, acetic acid, all kinds; antimony ore, barytes, diatomite, electrodes, emery stones, magnesite, nickel.

In making the above announcement the War Trade Board wishes to call attention to the fact that it is not in a position to speak authoritatively on foreign import restrictions, but is merely transmitting the information for the convenience of those on the War Trade Board's mailing list. Inquiries with regard to foreign import regulations should be addressed to the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C.

Permission to establish rates on bullion and copper matte dependent upon value has been granted by the Interstate Commerce Commission to apply from Mexican border points to St. Louis and to East St. Louis. Similar permission was granted to cover shipments of ore from Silver City and other stations in New Mexico to Peoria, Illinois.

The Pratt Claim Under the War-Minerals Relief Act

WASHINGTON CORRESPONDENCE

In support of their claim for $900,000 under the War-Minerals Relief Act, N. P. Pratt and his brother, George L. Pratt, the owners of the Chestatee Pyrites and Chemical Co., of Georgia, appeared on Apr. 15 and 16 before the War-Minerals Relief Commission in Washington. Edgar Watkins, an Atlanta attorney, also appeared in their behalf. The hearing was before the full commission. The testimony showed that operations were begun on the property late in 1916 without any request having come from the Government. Preparations were made to work the pyrites deposit on a comparatively small scale, but, following a visit from Fuller Calloway, representing the Secretary of the Interior, and after George L. Pratt had conferred personally with Secretary Lane, operations on a much larger scale were begun.

The claim had been carefully prepared, and the amounts expended prior to the visit of Mr. Calloway were separated from the expenditures thereafter. It was the intention of the owners to transport their product by motor truck to the railroad, 13 miles away. This method, however, limited shipments from the mine to 50 tons daily. Under the enlarged plan a railroad spur at a cost of nearly $200,000 was built to the mine.

The equipment included a concentrating mill of a rated capacity of 600 tons daily, and a dam to make possible the use of water for power. The company was just beginning operation under its enlarged program when the armistice was signed, with the result that the product, which had brought as high as 35c. per unit, fell off rapidly in price, with all prospects indicating that it cannot operate when Spanish pyrites begins to come into the market.

The commission insisted on great detail. The question, however, seems to be entirely one of amount. Apparently it is conceded by the commission that the claim comes, unquestionably, under the act. One of the reasons for taking it up first was that the claim has been excellently prepared. It is expected that there will be few claims which can show so clear a case in the matter of compliance with a governmental request. George L. Pratt testified that Mr. Calloway, in the presence of Secretary Lane, told him he would be a slacker if he did not undertake the full development of his property. That Mr. Calloway, who is one of the most prominent business men in Georgia, had full faith in the successful outcome of the venture was indicated by the fact that he offered to invest $200,000 of his own money in the enterprise. In addition to the direct requests from the Secretary of the Interior and his representative, other evidence was introduced to show that the Government was unusually interested in securing the product of the mines. The Secretary of Agriculture overstepped all technicalities and undertook extensive road-building operations to facilitate deliveries by motor truck. At the request of the War Industries Board, C. E. Juhlin, a mining engineer in Government service, was sent to the property, where he mapped out plans for ore development which were followed precisely.

A stenographic record is being made of all proceedings at hearings. Counsel for the claimants was allowed to take an active part in the first hearing, and it is safe to conclude that the commission will make no objection to the employment of attorneys if claimants deem it wise. The commission, however, is anxious to have it known that claimants without attorneys will have every opportunity to get before the commission all the facts surrounding their cases.

Mine Reconstruction in France

Although the securing of coal from the Sarre Valley will permit some activity in the iron industry in Alsace-Lorraine, Westphalian coal must be obtained if the industry is to be brought to full efficiency, in the opinion of Frank H. Probert, the dean of the College of Mining of the University of California, who has just returned from a visit to Europe. Professor Probert, who is consulting engineer of the Bureau of Mines, visited the mining areas in the devastated regions as a member of the Bureau of Mines committee which is studying the problems presented in the rehabilitation of mines there.

The physical damage done to the iron mines in Alsace and Lorraine, says Professor Probert, was not great. The principal injury has been caused by extracting the ore without thought of the permanency of the work, or advance development. Much time will be required to replace the steel plants, most of which were subjected to scientifically conducted destruction. Ample proof of the wilful nature of this destruction is in the possession of the Allied military authorities.

Those plants which can be operated must depend on German coal. Professor Probert is hopeful that an arrangement can be made which will permit of the importation of Westphalian coal. The absolute destruction of the coal mines in the Pas de Calais section makes it necessary to use either Westphalian coal or coal from the Sarre Valley. The Sarre mines, however, produce a poor quality of coking coal. It will not be possible to operate blast furnaces efficiently unless provision is made for the introduction of better coal.

Professor Probert estimates that it will be five years before it will be possible to dewater and reopen the mines in the Pas de Calais section, and from 10 to 15 years before they can be brought back to pre-war production. The flooding of the eastern end of the district offers the greatest problem in reclaiming these mines. It will be necessary to remove approximately 25,000,000 cu.m. of water. Although it is not known how much quicksand has come into the mines, Professor Probert believes that it will be possible to reclaim most of the old shafts and laterals. After making his inspection, Professor Probert reported his findings to the American Peace Commission.

Brazilian Manganese Industry

Exports of manganese ore from Brazil during 1917 were greater than during any previous year, according to a supplement to *Commerce Reports*, and amounted to 532,855 metric tons, all of which was shipped to the United States. The accompanying table shows manganese exports from Brazil during the years 1902 to 1917, in metric tons.

Year	Tons	Year	Tons
1902	157,295	1910	252,958
1903	161,926	1911	173,941
1904	208,260	1912	154,870
1905	224,377	1913	122,300
1906	121,131	1914	183,630
1907	236,778	1915	288,671
1908	166,122	1916	503,130
1909	240,774	1917	532,855

The Pan-American Conference In Washington

The governing board of the Pan-American Union on Apr. 9 decided to hold an important conference in Washington during the latter part of May or the first part of June. Invitations will be extended to the commercial and financial experts of all Federal departments, to the consular, commercial, and financial representatives of the Latin-American governments in the United States, to the United States Chamber of Commerce, to the National Foreign Trade Council, and to such organizations, firms, and individuals as are interested in the development of Pan-American trade.

It is expected that between 1000 and 2000 delegates will attend and that the opening and general sessions will be addressed by the President, the secretaries of State, of the Treasury and of Commerce, the Latin-American ambassadors, ministers, and consuls, senators and representatives, and heads of the Shipping Board, War Trade Board, War Finance Corporation, Federal Trade Commission, Federal Reserve Board, Tariff Commission, Council of National Defence, and other high officials.

Director General Barrett, in discussing the proposed conference, expressed a conviction that it will do more than any other recent influence to clear the way, after the confusion of the war, for a great and impending development of Pan-American commerce.

Price Stabilization

Overshadowing all other matters in official interest at Washington in the last week has been the controversy between the Railroad Administration and the Industrial Board of the Department of Commerce over the matter of price stabilization. The discussions have been followed closely by all industries, as the concentration of buying power in the unified administration of all railroads has brought many industries face to face with a most serious situation.

Although the whole controversy has centered around steel rails, it was really the coal operators who brought the question to a head. They declined to enter into any agreement with the Industrial Board until absolute assurance could be given that the Railroad Administration would be a party to the agreement. A number of statements have been issued in the matter, but the one by George N. Peek, the chairman of the Industrial Board, is regarded as being of unusual interest. It clearly outlines the issues in which so many industries are vitally interested. Mr. Peek's statement, slightly abridged, is as follows:

"The Industrial Board was formed to carry out a well-defined industrial policy to which the Government, represented by the President, the Cabinet and the Director General, was fully committed. There is no ambiguity either in the record or in the minds of the people of the United States as to just what that policy is. It is to avoid industrial stagnation pending a return from war to peace prices, to start the wheels of industry, to give employment to labor, to reduce the cost of living, to insure prosperity. Neither is there any ambiguity as to the methods to be employed in accomplishing this end. A scientific study of costs of production is to be made. Upon these studies of costs, prices of basic commodities are to be determined which shall be as low as cost of production will permit, which shall squeeze out all speculative or opportunist profit, and upon which industry can begin operations without fear of a considerable drop in the market. This policy and method are viewed by our people as the first constructive, comprehensive, and direct attempt that has been made by the Government to reduce the cost of living and secure fairness in trade. The announcement of the steel prices was immediately reflected by increased buying, and the new governmental policy and method thus were far on the way toward justification and success.

"To the complete success of this plan, however, there was one absolute essential: that the governmental departments should express the confidence of the Government in the execution of this most important policy. Especially is this true in respect of steel rails, in the buying of which the Government, through its control of the railroads, consumes a large percentage of the output.

"At this late date in the execution of the plan this important essential to its success has been denied by the Director General of Railroads, and by that denial the labor of the Industrial Board is set at naught and the Government is exhibited as setting up an industrial policy with one hand and destroying it with the other.

"Considering the first of the Director General's reasons for refusing to accept the steel prices—that the Industrial Board has no right to impose a price on the Railroad Administration—the technical prerogative of the Railroad Administration must be and always has been cheerfully conceded by the Industrial Board. But presuming the Government to have been committed to this important industrial policy, the board feels that the Railroad Administration is under a powerful, if not a compelling, obligation, either to have the governmental policy abandoned by the same source that announced it, and to assume full responsibility for the inevitable effect of such a step, or to support the policy, or to demonstrate that the Industrial Board has failed in its function and that the prices announced by the board are not fair.

"This brings one to the second of the Director General's reasons for his grave action—that *'in his opinion'* the prices are *'too high.'* The significance of this expression cannot be overlooked.

"A representative of the Railroad Administration is a member and a part of the board. Contrary to Mr. Hines' impression, this representative did not maintain that the prices of steel generally were 'too high.' He finally dissented only on the price of rails. That is not, however, the circumstance of greatest significance. Throughout the discussion, from its earliest word to this latest pronouncement, the figures representing costs of production were constantly available to the Railroad Administration's representative, and the basis upon which conclusions have been reached has been repeatedly presented to the advisors of the Director General and to Mr. Hines himself. Never have those figures been contested, never have additional or contradictory data been presented, never has the argument of the Railroad Administration been addressed to those figures nor to the conclusions drawn from them by the board. Repeatedly all these gentlemen have been urged to bring forward any facts which would assist the board in reaching a conclusion on prices lower than those approved, and never has this urging proved fruitful. The answer of the Railroad Administration has

ever been, as it is today, that the price at which the Railroad Administration will buy is within its own discretion and that *'in its opinion'* the prices approved by the board are *'too high.'*

"In fairness to the Railroad Administration, it must be admitted that, using the full effect of its power of monopolistic buying, it might secure a price on rails somewhat lower than that announced by the Industrial Board. The figures stand to prove, however, beyond all question, that such a price would be lower than production costs of any but one or two of the most highly organized, powerful, and lowest-cost producers. For example, the pre-war price of rails was $30. The increase over pre-war costs of production, for the United States Steel Corporation, in direct labor alone, excluding labor in transportation, is reported by that corporation to be $19.48 per ton. The price approved by the Industrial Board on rails was $47, or $2.48 less than the increase of cost of labor alone would account for.

"The inevitable result of the use of the enormous buying power of the Railroad Administration to reduce any price would be to create a situation which would have to be met by increasing of prices to the public, by throwing all railroad business into a monopoly of powerful producers, or reducing wages.

"In the opinion of the majority of disinterested men, all these results are highly undesirable, and are, of themselves, gravely inimical to industry and to the public welfare. These results alone are, however, of an importance relatively incomparable to the vastly greater harm inherent in the frustration of the industrial policy of the Government, and the forced return to the period of commercial and industrial stagnation which has continued since the signing of the armistice and which threatens to continue and grow worse in the absence of a strong governmental policy alleviating it.

"Doubtless the Director General is within his rights in insisting upon his technical prerogative to determine prices for himself, to exercise an arbitrary discretion in making that determination, and to use all the powerful means within his control to obtain the lowest possible prices on iron, steel, and coal for railroad consumption. The board insists, however, that, in the exercise of that right, the Director General must assume full responsibility for all the results of the course he has chosen.

"It is not the opinion of the board that governmental organization is such that important policies can be so lightly frustrated. The Railroad Administration's refusal to accept the steel prices puts a temporary check on the work of the board, but, before abandoning the vital industrial policy which it represents, the board will see that the whole controversy is submitted to the President for final decision."

March Pig-Iron Production

The pig-iron output for March amounted to 3,090,243 gross tons, or 99,685 tons a day, as compared with 2,940,168 tons, or 105,006 tons daily, in February, according to *Iron Age*. This average rate of production is 5% less than that in February, 6.5% less than in January, and 12.5% less than the 113,942 tons daily in last September, the record month. March output is less than February for the first time since 1913. There was a net loss of 40 furnaces during the month, 44 being blown out and only 4 going in.

Chromite in the United States

The total gross weight of all grades of chrome ore produced and shipped in the United States in 1918, according to the U. S. Geological Survey, was about 79,000 long tons, equivalent to 63,000 long tons of ore of 50% grade, such as is usually imported. In 1917 there was produced and sold in the United States about 43,700 long tons of chrome ore of all grades, of which California contributed 36,700 tons, Oregon 6700 tons, and Washington, Maryland, and North Carolina the remainder. Of the 1918 total, 56,200 tons came from California, 22,500 tons from Oregon, and the remainder from Maryland, North Carolina, Pennsylvania, Washington, and Wyoming. No shipments of chrome ore from Montana were reported. This is a much larger output than was estimated from the output in 1917, but not so large as would have been possible had the demands and prices early in the summer of 1918 continued through the year. If these had been maintained, the increase in output would have continued, the maximum production would probably not have been reached until near the end of October, and the total production of crude ore in 1918 would probably have been nearly 100,000 long tons, an amount believed to be approximately equal to the consumption of chromite by the United States during the year. The large domestic output showed that the United States has a great reserve of chromite, and under proper incentive could probably produce, at least for a few years, all that it needs, even for use in war.

Although there were about 700 owners of domestic chrome deposits in 1918, only about 270 actually shipped and marketed their output. Many others reported a large quantity unsold and on hand on Dec. 31, 1918, amounting to about 46,000 short tons of crude ore, equivalent to 30,000 long tons of 50% ore. Statistics showing stocks in the hands of importers, dealers, and consumers at the end of the year are not available.

The importation of chromite in 1918, as reported by the Bureau of Foreign and Domestic Commerce, was more than 100,000 tons, nearly 28,000 tons more than in 1917. The larger part of this ore came from Rhodesia, New Caledonia, and Brazil. The average cost at the shipping port of the imported ore, much of which was of high grade, was $28.17 a ton, and to this cost must be added the ocean freight.

From Canada the United States imported 20,949 tons of chrome ore, much of it of low grade, at an average value of $31.56 a ton. The price offered last summer for 38% domestic ore, f.o.b. cars main-line shipping point on Pacific Coast, was $47.50 a ton. These figures apparently support the claims of the large consumers that high-grade imported ore costs them less than low-grade domestic ore, and they are therefore calling for imports. On Jan. 15, 1919, a War Trade Board ruling went into effect removing all restrictions on the importation of chrome ore except from enemy countries. This ruling practically restores pre-war conditions as to chromite and apparently leaves to the domestic producer only a limited local market in which he may successfully compete with imported ores. It is evident that the imports have in large part destroyed the market for domestic ore.

"Broken Eggs Cannot Be Mended."—(Lincoln). Neither can "cashed-in" War Savings Stamps grow to their maturity value.

Editorials

Mrs. Phoebe A. Hearst

THE news of the death of Mrs. Phoebe A. Hearst will be received with regret by many interested in the mining industry, but more particularly by the employees of the Homestake Mining Co. Mrs. Hearst established, in Lead, S. D., a club for the use of the Homestake employees and their families. Of the many efforts along similar lines in other places, this club has probably achieved greatest success, and may well serve as an example of how such clubs should be organized and managed. A free library and kindergarten classes were also established in Lead.

To the University of California Mrs. Hearst presented the Hearst Memorial Mining Building for the use of the mining college of that university. It is a magnificent structure, and a fitting memorial.

Mrs. Hearst was not only a woman of great breadth of view, but one whose sympathy with and love for humanity found expression in innumerable acts of kindness, few of which were known to anyone except the recipients.

Ingeniería Internacional

THE initial issue of *Ingeniería Internacional* has appeared. As stated in the *Journal* of Jan. 4, the publication was established to provide a medium for the international exchange of ideas on engineering. It will record and visualize in a general way, for the benefit of engineers, contractors, and manufacturers, developments in American engineering; will promote international trade coöperation, and develop closer engineering relations between the United States and Latin-American and Spanish-speaking peoples.

The production of such a periodical necessarily entails much initial preparation and labor, but the *Ingeniería Internacional* staffs have succeeded well in their task, and the first, the April, issue presents a well-balanced number, replete with illustrations and with text covering a wide variety of subjects. The issue contains interviews with men prominently identified with engineering and industrial affairs, and original articles on commercial and technical subjects, in addition to miscellaneous abstracts and excerpts from other McGraw-Hill publications.

The extensive field which is covered by the new paper, the sources of information which are available to the publishers, and the inherent condition which has heretofore prevented coöperation and coördination of engineering ideas and methods, present an opportunity that demands the best in technical journalism.

There is a growing need for the development of good will between the United States and our Spanish-speaking neighbors; and an export-trade medium deserves encouragement and support. The initial issue of *Ingeniería Internacional* is of such creditable caliber that its helpful and broadening influence, in promoting the objects that called it into being, is assured.

Mining Industry's Post-War Problems

PREPARATORY to the signing of the armistice, in fact for many months before the happy event took place, the Allies were studying, through committees and commissions, the problems that were sure to arise at the close of the war. Our own Government somewhat tardily took up the same subject, and its officials, though handicapped by having post-war conditions confront them before the problems had been fully studied, are doing their best to handle the various situations intelligently.

The problems of the mines, though of national importance, are largely problems of individual properties, to be studied and solved by managers as they present themselves. Discussions that have already taken place and communications that have been published present the idea that principles should be formulated, and that we should then make our practice square with these principles. Theoretically, this may be the way to handle the situation, but all of the principles have not been laid down, and in the meantime troubles in the mining camps are pressing for solution, and it is the duty of the respective managements to deal quickly and intelligently with the situation that confronts them. A study of what one's neighbors are doing under similar circumstances and how best to apply existing remedies to one's own conditions holds more promise of early solution than does the study of principles.

The miner's problem in a nutshell is, "How shall I keep things going in the face of high costs of labor and supplies and low price of metal produced?" Though this may not be his only problem, it is the most important at the moment. If the pumps and the hoists could be stopped, if the stamps could be hung up and the furnace blown out, and all the men with their families sent away on a week's picnic, all would be well. But plant and equipment rust and deteriorate more rapidly when idle than when in use, and they must be kept in good condition. And, of all the machines, the human machines of the plant are the most delicate and need the most particular care. We say human machines advisedly, because each man on the works, from manager to mucker, represents a cog or wheel in the big machine. The human machine must be provided with fuel every day if it is to be kept in fit condition and ready to produce.

It is right here that the small or personally owned property possesses a great advantage over the large corporation. Where personal contact exists, friendly relations also exist, and difficulties tend to disappear more rapidly. When the boss can say to Bill Stimson, the hoist engineer: "Bill, dope up the cable good, and smear the engine with white lead and lard. Don't know when we'll start again. Then come out to the ditch with a pick and shovel. There is a week's work on the hillside"—when such a speech can be made and accepted seriously, difficulties are not so great as in the case of the larger organization. We can imagine Bill taking his pick and shovel and going to work with-

out any resentment toward the boss and glad of the chance to be doing something, but we could not imagine supine acquiescence in the event of the Anaconda management directing all of its hoisting engineers to report for duty on the railroad grade on Monday morning at half their normal wages.

It may be old-fashioned, but it is wise, to cultivate the personal contact and individual responsibility whenever possible. The large organization has its advantages, but also its disadvantages. It is necessary, and, like the large, delicate engine, runs economically while all is going well, but needs the greatest care or one loose pin will throw the entire plant into a state of idleness and disorder. Though there are certain advantages possessed by the small concerns, this is not a good reason to advocate the division of the big organizations into smaller parts.

And this brings us to another interesting situation. War conditions and post-war conditions have caused cessation of operations at many small mines and prospects. This is serious, because many of the great mines of the future must grow from the small mines and prospects of the present. Individual initiative and enterprise have made America what it is today, and the cultivation of these traits has, in 150 years, made us what we are. The suppression of them for centuries has made Russia what she is. If reconstruction is necessary in the mineral industry, it is not from the top to the bottom, but from the foundation upward. The top is in a fair way to take care of itself.

Renewed and substantial encouragement for the small operator may not sound like an important post-war problem, but it is the foundation upon which must stand one of the columns of our national structure of the future. Its neglect will mean one weak member that may weaken or wreck the whole edifice.

Industrial Coöperation

THE most notable speaker at the recent Industrial Conference was Charles P. Steinmetz. In a simple direct way Dr. Steinmetz discussed industrial coöperation. Combining a wide engineering experience and intimate contact with industry with the keenest of analytical minds, his conclusions cannot but be illuminating and worthy of extended consideration. He pointed out the weakness of all paternalistic schemes for the improvement of labor conditions, and indicated the offensiveness to the wage earner of much of the misdirected welfare work. In speaking of the relationship of capital and labor, the necessity of labor sharing not only in the profits but in the management of industry, as well, was presented as the direction in which industry must look for a solution of present difficulties. The working out of the problem along the lines suggested is, as Dr. Steinmetz remarked, a matter of slow growth and gradual development rather than of sudden change. There is much of value in Dr. Steinmetz's suggestion of the plan of "wage dividends," together with all that it implies in representation in management and control.

The Courage To Experiment

THROUGHOUT the whole fabric of human life and endeavor is woven the thread of chance. Great social and economic investments are merely experiments, depending always to some extent on chance for their success or failure. But, though chance may wield so potent an influence, the primary need for initiative must not be overlooked. For initiative leads to experimentation, and experimentation to achievement. And achievement seldom comes by chance.

Experiments are often termed failures in that they indicate the impracticability of a certain line of action. They are, however, almost invariably successful in eliminating from consideration the less essential proposals. It is feasible to forecast happenings and reactions in certain instances with accuracy, but in many cases it is impossible. The problem resolves itself into one of preliminary experimentation, carried out on a large or small scale, as circumstances dictate. Small-scale experiments are, relatively considered, cheaply performed; they can often be conducted to give results that may be duplicated to a nicety on a large scale, but they are not always applicable. Large-scale experiments involve heavy expense, and it often requires courage to institute them.

The war has broadened the outlook; and unheard-of sums have been spent in the encouragement of local production. Some experiments resulted in failure, but the success of the remainder has justified the expense tenfold—it has proved that the resources were there, and that it was just a question of developing a latent asset with sufficient capital and courage.

America's success during recent years has been due largely to an exceptional ability to finance experiments on an unprecedented scale, aided, also, by the spirit which recognized the value of taking a chance and risking high stakes when the prizes are of unmeasurable worth and of illimitable import and national significance.

Big problems involve big expenditures. Caution with regard to a conclusion as to the necessity for incurring such liabilities, where vital industrial or individual progress is at stake, is justified only where complete failure is a possibility. In many cases, however, some measure of success in any logical scheme can be forecast. Delay under such conditions is unpardonable if it is realized that the improvement can be achieved only by means of a proportionate outlay.

Nowadays, nations that are unwilling to incur expenditures which may be termed vast are likely to find themselves left behind in the race for a national supremacy based on the contentment, comfort, and sociological position of their people as a whole. The Great War has taught the world that the reason for delay in furthering vital schemes for national improvement and well-being are mostly hollow and inadequate. An inexcusable conservatism, coupled with an inherent dread of the consequences of spending large sums of money, was often the cause. Lack of justification for the outlay was sometimes pleaded as an excuse for delay. Since August, 1914, however, new standards have been set; and, both with regard to expenditure and achievement in a good cause, no limits have been considered. In a few cases waste resulted, but the goal was "neck or nothing"; and the winning post was reached with the realization that there was ample justification for adopting unusual and drastic measures which involved colossal expenditures, when apathy and procrastination would have resulted in the degradation of all the ideals worth fighting for.

When the goal is clear and unmistakable, there should be no delay in setting about to reach it. Costs are only relative. It is the result that counts.

Save, and Then Save

WHETHER we are in sympathy with the Victory Loan or not, whether we subscribe or leave that duty to our neighbors, whether we prefer to lend money to the Government or have the Government take from us, in the form of taxes, what it needs—whatever our point of view—one thing is certain: the bills are our bills, and we must ultimately pay them. Each and every one of us must contribute voluntarily or involuntarily, knowingly or unknowingly, and we have got to save to pay these bills.

It may be tiresome to be preached to, especially if one does not feel in the saving mood. But it is not tiresome to him who feels the necessity of thrift; rather, he has his eyes open for the possible chance of developing thriftiness along new lines. Here is where we all need help. We need some suggestions that will enable us to get more out of life or put more into it; some suggestions that will make it possible for us to get 10% more service out of a belt or a hoisting rope, or it may be a pair of shoes, or out of a gallon of oil or a pound of dynamite. The man who can give us hints along these lines is the one we want to hear or the author we want to read.

Perhaps the *Journal* is optimistic in expecting that a number of its readers are going to send in suggestions that will produce little savings here and there around the mine and mill, but it hopes for and expects them. Nothing will be too small to be disregarded, and the total may amount to a respectable figure.

Perhaps one of the first sources of thrift that the local manager should have in mind is that of careful buying; the endeavor to get the full worth of money expended; the insistence upon quality with respect to all purchases. Today there is scarcely an article to be purchased for the mine that is priced at anything like what can be regarded as normal. Tomorrow the quotation may be a trifle lower and next week a shade less, and on this recession one may be inclined to place orders, but if he does so it will behoove him to bear in mind that the manufacturer is anxious to sell and equally anxious to avoid loss.

Does the reduction in price represent any reduction in quality of goods? It is well to bear this question in mind and insist upon the manufacturer doing his part in the thrift campaign. The consumer has been pretty thoroughly lectured in regard to spending wisely, but we doubt if the manufacturer has been given corresponding advice and attention about producing wisely. The waste involved in the production and use of cheap inferior goods is large, and the manufacturer's practice in this direction cannot be condoned through his statement that he makes what the people want.

We can reach the producer and set him on the right road through our insistence that when we buy we must have the best. This is one item in practical economy and practical thrift through which we may pay a portion of the bill that stands against our account.

Concentration of Iron Ores

SHIPMENTS in the Lake Superior iron-mining districts, which to date have produced somewhat over 900,000,000 tons of ore, reached the high point in 1916, when they amounted to 66,658,466 tons, although each of the years following recorded a slight decrease in the shipments from the season preceding. In a general way, it may be said that this drop has not been due to lack of ore reserves, because production has depended mainly upon the demand of the furnaces, and their requirements have regulated the operation and output of the mines.

Recent estimates show that the ore of commercial grade will be exhausted within comparatively few years and that the remaining iron-ore resources in the district will average less than 45% in iron. The gradual removal of the higher-grade deposits has led to an increase in the mining of lower-grade ores, and the latter will, in time, necessarily replace the former ores.

Iron-ore smelting requires the use of high-quality grades of ore, and, though the larger proportion has been supplied direct from high-grade ore deposits, a certain percentage has been procured from lower-grade bodies, the ore from which, after being mined, has been treated by washing methods.

The growing interest in iron-ore concentration, which has been particularly noticeable on the western part of the Mesabi Range, has been the result of the realization that there is much available ore in that section that may be made suitable for furnace use. And this condition will doubtless continue. The ores of the western Mesabi lend themselves particularly well to treatment by simple methods, for the ore structure is such that ordinary means of concentration may be used, and the separation process as applied to mill construction is largely a matter of mechanical arrangement. The Trout Lake concentrator of the Oliver Iron Mining Co., at Coleraine, Minn., which was the first plant to be placed in operation on the Mesabi Range, was completed in 1910, and now consists of six units and has a capacity of 3,000,000 tons of crude ore per season. In the district 11 plants are now operating and others are under consideration or are being built. In his article, "Iron-Ore Concentration on the Mesabi Range," which appears in this issue, F. A. Kennedy has outlined the general practice as followed in iron-ore washing in that district, together with suggested improvements which will be appreciated because of the increased interest which concentration methods will continue to possess.

The United States Steel Corporation

THE winning of the war may be attributed to many agencies, but not the least of these was the important part played by the United States Steel Corporation, whose varied operations of the last year mark a period of notable accomplishment. The seventeenth annual report, abstracts of which are published in this issue, contains a record of remarkable achievement by the subsidiary companies.

Totals of production and shipments of the various companies during 1918 were less than those of 1917, but the shortage was offset by increased output in special lines, and the remarkable successes which attended operations that were a departure from former practice. Among the increases in output may be mentioned the production of plates, extensively used in shipbuilding, which totaled 2,171,362 tons, or an increase of 47.3% over the 1917 output. Notable among the strictly war-work developments were the study of chemicals for gas masks and the making of rolled sheets for helmets, by the American Sheet and Tin Plate Co., and the manufacture of gas and mortar shells from welded pipe by the National Tube Company.

During 1918, as in past years, the officers of the corporation continued the extension of welfare work for the benefit of employees. This commendable practice has been one of the secrets of the successes which have marked the operations of the corporation, and its example may well be followed by all employers of labor, for it has repeatedly been proved that coöperation between labor and capital begets a healthy growth for industry.

Loyalty of employees is not fostered by a spirit of paternalism, and the policy which gives workmen of the United States Steel Corporation the opportunity to subscribe for stock upon easy-payment terms may be emulated to advantage by other employing concerns.

BY THE WAY

China exhausted most of its own supplies of jade stone many centuries ago and now depends upon Burma for the stone, says *Commerce Reports*. The chief centers for jade carving are Canton, Peking, and Soochow.

As a suggestion in passing, it might be mentioned that composite names have been frequently adopted in various mining districts as designations for mines, plants, and places, and their use strikingly suggests the romantic side of the mining industry. One of the latest of these to reach us is from the Cobalt district, namely, Coniagas, the syllables being formed respectively by the symbols Co, Ni, Ag, and As. Another is the designation of the Cuyuna Range, in Minnesota, the name being composed of the syllables "Cuy" and "Una." The former is a contraction of the given name of Cuyler Adams, who was active in the early exploration of that territory, and the last syllable is the name of his dog, "Una."

The following bona fide copy of a letter received by a mining engineer was sent to us recently and illustrates the necessity for a close study of phonetic spelling and the fertile imagination that is required by him who professes an interest in mine prospects:

"Der sur I have groap 8 gold clames wit a good shon for a big min it is Popry Dick Ha a wet of200 betwn wals un wal is Sist othr is granit can be trased 3 mil ur mor. if you ur yor find wans sumtin Big were you will Hav Lots of ore 7 of the clames shos good Iwill giv 1 yer too see wat Can find ifthe Bunch ant Big a nuf we coud git 4 more all the Properts a roun me is good you PlesLet me No if you Can handl this Propirty You Hav 6 feet of ore too start on a shaft Sout West End 6 feet or Nort Est End from cras root it is Lo grade but you will Los of it Had ases $5 too $32.50 in gold cares a Little copper & sum Silver 2 of clames Shos well in Silver you can git all valus wit tin 7 mils from railrod& Smilter

Wit a rod all doun $( ) is the Pris 3 yers too Pay & oblig yors

X.

Cap'n Dick thoughtfully puffed his tightly packed pipe of Peerless. "M'son", said he, "tha worl' do change. 'Ere is all creation h'upset over fitin' tha 'Uns, tha peace problem 'angin' fire, h'industry in a 'uge turmoil, an' w'ere with 'igh costs an' all are we gawin'? Dam-me, sometimes I wonner jus' w'ot's to be tha h'end. But with all this 'ere, I can't say as 'ow you an' me 'as cause to worry. Leave 'er w'ere sha's to, m'son, an' these 'ere diplomats an' politicians an' h'arbitrators will work un h'aout. But w'ot do 't me tremendus is this 'ere h'interference with pers'nel liberty. Dam-me, do seem as 'ow these days man can't raise 'is 'and to blaw 'is nose but w'ot some chap mus' tell 'im 'ow to do un. Take this 'ere pro'ibition. 'Ere be I an' there be thee, back long we. Thee says to me, 'I'll stan' thee to a pint,' and daown we gaws af'er shif' to tha pub. We may 'ave one, we may 'ave ten, but 'ome we gaws to tha missus, an' shows h'up bright an' h'early nex' moornin' to tha mine. Min' you, m'son, I don't say there be not they 'oo don't make a 'og o' theirsel's, but tha 'ardship comes w'en tha h'innocent suffer with tha guilty. I tell 'e, m'son, this 'ere chap 'oo wrote tha 'Miner's Solace' in tha *h'Engineerin' an' Minin' Journal* naws wot 'e's talkin' abaout. These 'ere 'ipocrites 'oo wants to 'ave all smokin' stopped mus' be crazy. 'Oo ever 'eard of a man takin' five withh'out a smoke? An' 'ow in 'ell do they think a chap can figger 'ow bes' to blas' a stope? Smokin', m'son, is a 'abit in minin' but, dam-me, there never was a better. 'Ere, you, let's 'ave a bit moor Peerless."

State Senator O. L. Sparks, of Galena, Kan., has the reputation in the Joplin district of having made and spent more money than any other mine operator in the lead and zinc fields. Says the Kansas City Star: "Sparks made and lost most of his big money in the 'Badger Diggins.' The last time he went 'flat broke,' about six years ago, was when he was trying to get more money out of the old S. H. & S. A flood came, and he spent a large sum pumping out the water. Then, just as he got all the water pumped out, his mill burned, and almost before the ashes got cool another flood came, and he had more water than at the beginning.

"When he took stock of himself Senator Sparks found he had nothing and was $20,000 in debt. That was only six years ago, and today he owns the finest house in Galena, a 16-room home with billiard parlors and dancing pavilions; a lot of Galena property, more than 1300 acres of land, five mines and other valuables.

" 'How did you make your last come-back?' he was asked.

" 'Well, sir, one day I happened to be in Joplin and met a fellow who said he had lost $5000 in a mining venture and that if his wife found it out he would catch hell. He said another mine operator had told him I was a lucky dog, and that if he wanted to get his money back I could get it if any man could.

" 'I told him I myself was broke, but I had been broke so often that it didn't make much difference to me. I told him I knew of a piece of land I believed we could make a stake on and that if he would put up some money against my experience we would tackle it.

" 'He gave me $500, and I got a drill and went at it. I hit ore in the first hole we drilled, and pretty soon he sold out when he had made back all he had lost and could go home to his wife without catching hell. I kept the mine and made $37,000 in a year and a half. Then I bought in "The Pup," and in a couple of years had a tolerably fair stake. With some other parties I bought "The Pup" land for $47,000 and I haven't hit bottom since.' "

NEW PUBLICATIONS

Yacimientos Carboniferos de las Provincias de Pallasca, Huaylas y Yungay. By Juan M. Yáñez León. Pp. 85; illus. Bull. 90, Cuerpo de Ingenieros de Minas del Peru, Lima, Peru.

The pamphlet was evidently issued for the purpose of disseminating information with regard to the economic coal deposits of Peru. The geological and structural features are considered in detail, and descriptions are given of the deposits and their development toward an economic basis.

Handbook of Mechanical and Electrical Cost Data. By Halbert P. Gillette and Richard T. Dana. Pp. 1734. McGraw-Hill Book Co., Inc., New York. Price, $6.

This book was written to fill a need that was felt by mechanical and electrical engineers, and consists of notes and data that have been collected and formulated by the authors in the practice of their professions. The indispensability of the information thus collected prompted its arrangement and publication in book form. The main purpose of the book is to place in the hand of the engineer, in the most convenient form for reference, the largest practicable amount of information bearing upon economic and intensive construction, production, and transportation in the mechanical and electrical fields. So far as possible the material has been classified along the lines of the work that one man is likely to be called upon to undertake; and a comprehensive index supplements the volume and enhances its value. In writing the book, the authors have borne in mind the requirements of the designer, the appraiser, the chief of construction, the superintendent of operation, and the engineering student. Among the various subjects treated are: General economic principles; depreciation, repairs and renewals; buildings; chimneys; moving and installing; fuel and coal handling; steam power; internal combustion engines and gas producers; hydro-electric plants; first cost and operating expenses of complete electric light and power plants; overhead electrical transmission and distribution; underground electrical transmission and distribution; lighting and wiring; belts, shafts and motor drives; compressed air; gas plants; pumps and pumping; conveyors, hoists, cranes and elevators; heating, cooking, ventilating, refrigerating, and ice-making; electric railways; and miscellaneous costs. The book is complete and the data are reliable. It should find a place among the most frequently consulted books in the engineer's library.

Industrial Goodwill. By John R. Commons. 6 x 8¼. McGraw-Hill Book Co., Inc., New York.

An excellent little book, and appropriately named. Every employer of labor and every employee should read it. A careful study of its contents should create a better understanding of what is meant by goodwill and what is necessary for the development of industry along rational lines. A few quotations may appropriately be given. In speaking of labor, the author says:

This I call the machinery theory of labor. Labor is not a commodity—its value determined by demand and supply—but each laborer is a machine—its value determined by the quality of its product. The theory is not new. Its application is a new discovery in science and engineering. The commodity theory is the merchant's theory of buying and selling. The machinery theory is the engineer's theory of economy and output. Man is, after all, the most marvelous and productive of forces of nature. He is a mechanism of unknown possibilities. Treated as a commodity, he is finished and ready for sale. Treated as a machine, he is an operating mechanism to be economized.

Again, under the subject of goodwill:

Scientific management picks out the individual and offers him the inducement of making more money. It separates him out from the group with which he has consciously or unconsciously, perhaps, identified himself. It cuts across the solidarity of labor as a class, unmindful that the laborers are competitors with each other, that they are buying jobs which they feel are limited in supply, and that their feeling of solidarity on this account reprehends the one who injures his fellows by lessening their chances for jobs, or who reduces the level for compensation for all by his self-seeking competition.

But the goodwill of labor is a collective goodwill that does not play one laborer against another, or the unemployed against the employed, or take advantage of the needs of a class, but acknowledges labor's solidarity of interest as well as the individual laborer's self-interest.

Scientific management, since it begins and ends with individuals separated from their fellows, has the defects of autocracy. It means government by experts. An expert comes into the factory and makes a study of the operations of the selected individual. That individual and his fellow-workers are much concerned about his time studies, his stop-watch, his cold calculations, which decide for them the amount of work that shall be portioned out for the task. But they cannot be consulted. They are objects to be investigated, not investigators.

But goodwill is reciprocity. It is not government at all, but mutual concession. It yields as much to the prejudices and passions, to the conservatism and even suspicions of patrons as it does to scientific knowledge of what is good for them. Goodwill is not necessarily a virtuous will, or a loving will; it is a beneficial reciprocity of wills, and whether there is really a benefit or really a reciprocity is a matter of opinion and mutual good feeling as much as a matter of science. . . . .

For it is goodwill that converts the "class struggle" of socialism into class harmony. It converts retaliation into reciprocity. Where it does not exist, there the public, more and more, is turning to another theory, not merely the goodwill theory of labor but the public utility theory of labor.

Other extracts might fittingly be reproduced to illustrate the trend of the book, which is distinctly of a constructive nature; but sufficient has been given to show the fairness of the author and his deep insight into the many industrial problems. The concluding paragraph of the work has a peculiar significance at present and is therefore worthy of quotation:

No nation hereafter, not even America, can live to itself alone. America has come out of the war the one great industrial power of the world. Other nations are bankrupt. America is their creditor. America has the capital, the resources, the shipping, the man-power. America may use its power as Germany tried to do. It may subsidize its capitalists and trusts and make a science of dumping. It may make other nations eventually its enemies. Or it may submit its excessive power to be regulated in partnership and equality with other free nations. The struggles of the future are industrial. The world may be governed by supply and demand, and America will win by superior control over supply. Or the world may be governed in partnership, and America will take an equal chance of winning in the race of international goodwill.

Compressed Air Plant. (Third Edition.) By Robert Peele. 6 x 9¼, pp. 485, illus. John Wiley and Sons, New York.

As stated by the author in the preface, there have been recent changes of importance in the details of design of both compressors and rock drills, and the issue therefore contains many replacements of the cuts appearing in the two earlier editions, besides the necessary changes in text. Part I of the volume treats with the production of compressed air, and includes the development, structure and operation of various types of machines. Part II comprises information and details concerning the transmission and use of compressed air. This section includes a complete description of various types of reciprocating and hammer drills, together with statements of their performance, records and costs. Other applications of compressed air, such as used in coal-cutting machines, pumps, and haulage, are considered. Demonstrations and descriptions of certain of the older compressors and drills are retained, and the arrangement of the issue is such that the entire subject is treated in a full and able manner.

Production and Value of Mineral Products in Michigan for 1917 and Prior Years. Publication 27, Geological Series 22, Michigan Geological and Biological Series, R. C. Allen, director. 9¼ x 6¼, pp. 225.

The data include statistical tables of production and value, historical sketches, and lists of producers of metallic and non-metallic minerals in Michigan.

Personals

F. D. Chase has removed to Dedham, Mass.

P. E. Butcher is vice-president and general manager of the Dominion Co. at Danville, Ill.

William Holzhauer is with the Aluminum Castings Co., being employed in the metallurgical department.

E. A. Sporley, of the Bureau of Mines, as completed a tour of inspection of the Mesabi Range mines.

David D. Irwin has accepted a position with the Phelps Dodge Corporation in the office of the president.

H. L. Batten is in Rossland, B. C., engaged with the Consolidated Mining and Smelting Co. of Canada.

R. W. French, formerly situated at Ingot, Calif., is now with the Department of La Union, San Sebastian, Salvador, C. A.

M. B. R. Gordon is vice-president and managing director of the Molybdenum Products Co., Ltd., Wilberforce, Ontario.

Ralph E. Barker has accepted a position at the Tacoma Smeltery, Tacoma, Wash. He was formerly with the Garfield Smelting and Refining Co.

Alexander Faulds, of Vancouver, B. C., left recently for China on a professional business trip and will be absent for several months.

L. Stepanoff, mining engineer, has established an office at Grand St. 151, Blagovestchensk on Amur, Amur Province, Russia.

S. D. Callaway and **J. E. Davis** have formed a partnership under the name of the Chotaw Engineering Co., Patrick Bldg., Poteau, Okla.

Paul R. Forbes has resigned his position with Shewan-Tomes & Co., of New York, and is now situated at 712 Prospect Ave., El Paso, Texas.

Oliver U. Bradley is U. S. Oil and Gas Inspector for the Department of the Interior at Muskogee, Okla., with offices in the Federal Building.

B. R. Mackay will be in charge of a party sent out by the Geological Survey of Canada this year on an exploration trip into British Columbia.

Howland Bancroft, of Denver, announces that he will be associated with **B. L. Thane** after June 1, with headquarters in the Crocker Bldg., San Francisco.

L. K. Armstrong, secretary-treasurer of Columbia Section of the A. I. M. M. E., has been elected president of the Spokane Engineering and Technical Association.

Claude E. Amidon, who has been employed in the Chemical Warfare Section at the Astoria Heat, Light, and Power Co., has removed to 40 Block F., Pueblo, Colo.

Charles W. De Witt, until recently mine superintendent of the Chiksan Mining Co., is en route to Omsk, having accepted a position with the U. S. Government for duty in Siberia.

Col. James R. McLean, of the British Army, has arrived in New York en route to Mexico, to confer with Carranza in regard to 15,000,000 acres of British oil land confiscated in 1915.

C. O. Stillman, of Toronto, recently vice-president of the Imperial Oil Co., has been elected president in place of the late Hon. W. J. Hanna. A. M. McQueen succeeds to the vice-presidency.

Paul W. Gaebelein, mining and metallurgical engineer, who served during the war as a first lieutenant, Ordnance Reserve Corps, has opened offices at 17 West Nintah St., Colorado Springs, Colorado.

William Bischoff, assistant general superintendent of the Dominion Iron and Steel Co., Sydney, N. S., has resigned to accept the position of assistant general superintendent of the Lukens Steel Co., of Philadelphia.

F. L. Gilman, formerly works manager of the National Conduit and Cable Co., is now the European general superintendent for the Western Electric Co., being in charge of the manufacturing plants in England and on the Continent.

F. E. Lucas has been appointed to the newly created position of economy engineer with the Dominion Steel Corporation of Sydney, N. S., with the view of eliminating wasteful practices and the introduction of economical processes.

Federico García Caceras has severed his relations with Negociacion Minera E. E. Fernandini, Cerro de Pasco, Peru, and will become metallurgical engineer for Compania Gallofa-Consolidada de Colque-Chaca, Bolivia, S. A.

A. W. Carroll, assistant superintendent of the Raritan Copper Works, and **S. Skowronski,** in charge of the Research Department, left recently on a business trip, during which they visited the Baily electric furnace plant at Alliance, Ohio; the Edgar Thomson steel works, and Kopper's byproduct coke plant, at Pittsburgh, Penn.

Amor F. Keene anounces that he has accepted the position of consulting engineer and member of the American advisory committee of the Gold Fields American Development Co., Ltd.—the representative in America of the Consolidated Gold Fields of South Africa, Ltd., of London—with headquarters at the offices of the Gold Fields American Development Co., Ltd., 233 Broadway, New York.

A. C. Clark is manager of the Raritan Copper Works; **F. L. Antisell,** superintendent; **A. W. Carroll,** assistant superintendent and **N. W. Pierce,** office manager, according to a revision of the positions of executive officers of the works made at a recent meeting of the board of directors. Mr. Pierce has also resumed his former position as chairman of the General Safety Committee.

Societies

Colorado Scientific Society held its 335th regular meeting on Apr. 5, at the Denver Athletic Club. Albert C. Crehore delivered an address on "Atomic Phenomena."

American Society of Civil Engineers held a meeting on Apr. 16, when W. G. B. Thompson spoke on the "Development of New Jersey's Highway System and Its Relation to Hudson River Vehicular Tunnels and Ferries."

American Institute of Mining and Metallurgical Engineers has appointed a committee to coöperate with the Canadian Mining Institute consisting of E. P. Matheson, A. R. Ledoux, and L. K. Armstrong. D. H. McDougall, W. Miller, and R. H. Stewart will represent the Canadian Mining Institute.

Engineers' Society of Western Pennsylvania held a joint meeting with the Pittsburgh sections of the American Chemical Society and the American Electrochemical Society on Mar. 25. The subject discussed was "Gas, Smoke, and Flame in This War and the Next," by William H. Walker, Colonel, Chemical Warfare Service, U. S. A.

Association of Members of American National Engineering Societies in Cuba has been recently founded to foster the interests of various national engineering societies represented in Cuba. Its membership is composed of all the prominent engineers in Cuba. The year book has just been published. Carlile Ulbricht, secretary, Empedrado No. 17, Havana.

Industrial News

Mine and Smelter Supply Co. advises that B. W. Hills has been appointed manager of sales of the machinery and supplies department at the Denver office.

Chicago Pneumatic Tool Co. announces the appointment of F. V. Sargent, district manager of sales in the Boston territory, succeeding F. S. Eggleston, with headquarters at 182 High St., Boston.

A. P. Green Fire Brick Co., of Mexico, Mo., has opened an eastern district sales office in New York City at 30 Church St. Howard C. Thayer, formerly field mechanical engineer for the J. G. White Engineering Corporation at U. S. Nitrate Plant No. 2, is in charge.

Cutler-Hammer Manufacturing Co. announces that E. C. Cherrington and T. R. Cooley, who for several years have been in the sales service department at Milwaukee, have been transferred to the Pittsburgh office of the central district, Mr. Cherrington becoming office manager and Mr. Cooley engineering correspondent.

Paul O. Abbe, Inc., is the title of the new organization created to succeed the business of Paul O. Abbe. The new corporation has purchased a site on which new buildings are being erected to afford increased manufacturing facilities. Mr. Henry Selman, one of the original inventors and developers of the grinding mill, is associated with the new corporation.

American Manufacturers' Export Association has appointed the following committee on education for foreign-trade service: W. W. Nichols, Allis-Chalmers Manufacturing Co.; G. H. Carter, W. R. Grace & Co.; H. E. Cole, Standard Oil Co.; H. H. Merrick, Chicago Association of Commerce; H. S. Smith, Gulf States Steel Co.; E. P. Thomas, U. S. Steel Products Company.

J. F. Davis, Harris Trust Bldg., Chicago, has taken over from the du Pont Powder Co.'s plants a considerable number of boilers which have been in use from three to six months, and is in the market to make contracts to install these boilers ready for operation. Every boiler is guaranteed. Prices will be furnished upon request. A number of well-known manufacturers are represented, and various types of construction are included. New Keeler boilers can also be furnished.

Huff Electrostatic Separator Co., which has been situated for the last 14 years at 60 India St., Boston, has recently acquired and fitted up a large plant at Arlington, Mass., a suburb of Boston, to which it has moved its offices, ore-testing and chemical laboratories and works. It maintains a well-equipped laboratory for the purpose of making either preliminary or complete tests showing the results that can be obtained commercially in the separation or concentration of minerals, abrasive materials, and reclaiming valuable contents of many waste materials by the Huff electrostatic process. H. B. Johnson, an expert on graphite refining, is general manager of the company.

The Oliver Continuous Filter Co. reports an export business for 1918 which is practically twenty times greater than the company's export business five years ago. Recent foreign sales include six 12-ft. diameter by 16-ft. Oliver filters, with complete vacuum equipment, to the American Smelter Securities Co. for its Veta Grande mill at Parral, Chihuahua, Mexico. Another Oliver installation in Mexico during 1918 was that of a 14 x 18-ft. filter at the mill of the Alvarado Mining and Milling Co. at Parral. During the present month the Oliver company is shipping duplicates of the Veta Grande filter to the Benguet Consolidated Mines, in Benguet, Philippine Islands, and another to a cyanide plant in the Dutch East Indies, which is being installed by the Netherlands government.

New Patents

United States patent specifications may be obtained from "The Engineering and Mining Journal" at 25c. each.

Drill Bit. Granville A. Humason, Shreveport, La., assignor, by mesne assignments, to C. E. Reed, Houston, Tex. (U. S. No. 1,294,106; Feb. 11, 1919).

Dump Cars, Locking Mechanism for. Alexander M. Gow, Duluth, Minn. (U. S. No. 1,294,088; Feb. 11, 1919.)

Dump Car. William D. Skidmore, New York, N. Y.; Emmeline M. Skidmore, administrix of the estate of said William D. Skidmore, deceased, assignor of one-half to Francis de Lancey Robinson. (U. S. No. 1,293,954; Feb. 11, 1919.)

Inclined Screen. Lewis G. Rowand, Brooklyn, N. Y., assignor to the New Jersey Zinc Co., New York, N. Y. (U. S. No. 1,294,309; Feb. 11, 1919.)

Lift Pump. Frank English, Fresno, Calif. (U. S. No. 1,294,069; Feb. 11, 1919.)

Mining Sulphur, Apparatus for. John W. Peters, Roslyn, N. Y. (U. S. No. 1,293,902; Feb. 11, 1919.)

Oil-Well-Cleaning Appliance. William J. Hogue, Kansas City, Mo. (U. S. No. 1,293,777; Feb. 11, 1919.)

Rock Drill. William A. Smith, Denver, Colo., assignor to the Denver Rock Drill Manufacturing Co., Denver, Colo. (U. S. No. 1,293,960; Feb. 11, 1919.)

Rotary Boring Drill. Howard R. Hughes, Houston, Tex., assignor to Hughes Tool Co., Houston, Tex. (U. S. No. 1,292,608; Jan. 28, 1919.)

Rotary Drilling Tool. Charles P. Mayner, Montebello, Calif. (U. S. No. 1,292,842; Jan. 28, 1919.)

Tungsten. Process of Separating Tungsten Compounds from Substances. Carl Andersen and Eric Hjalmar Westling, San Francisco, Calif. (U. S. No. 1,292,559; Jan. 28, 1919.)

Zinc Oxide. Preparing Pigment. Leland E. Wemple, St. Louis, Mo., assignor to American Zinc, Lead and Smelting Co., Boston, Mass. (U. S. No. 1,292,976; Jan. 28, 1919.)

Editorial Correspondence

SAN FRANCISCO, CALIF.—Apr. 11

February Production of Petroleum in California totaled 7,841,848 bbl., or an average daily production of 280,066 bbl., an increase over January of approximately 2700 bbl. in daily average. Shipments from the fields in February totaled 7,470,373 bbl., adding 371,465 bbl. to the crude-oil stocks, which at Feb. 28 totaled 32,671,059 bbl. The number of wells producing in the 11 active fields in the month was 8659. New rigs installed, 36; number of wells started drilling, 318; number of completed wells, 42; abandoned, 2. Field prices at Mar. 15 remained as of May 1, 1918.

Montebello Oil Field, which has attracted attention for last two years for its production of both oil and water, had produced up to Feb. 1, 1919, a total of 8,700,051 bbl. of oil. The production comes from two strata or zones of oil sand. The first or upper zone has yielded 1,876,121 bbl. of oil and 121,332 bbl. of water from 19 wells which produce exclusively from the upper zone. A number of wells producing from both the upper and lower zones are not included in the 19 wells. Two of these 19 produced 99,859 bbl. of water, or 82% of the total water yield. The total production of oil from the second oil zone up to Feb. 1, 1919, was 6,823,930 bbl. Three wells produced 410,201 bbl. of water of a total of 648,361 bbl. The largest water producer of the three is now taking steps to remedy the condition. It is notable that the large water producers in the two zones of the Montebello field have been neither drilled nor operated according to the requirements of the oil and gas department of the State Mining Bureau. But there is at present an inclination to observe the rules regarding shutting off the water.

High Price of Fuel Oil paid by California producers was made the subject of special attention in the annual report of the State Railroad Commission for the year 1917-1918. The report states that the price more than doubled in 1918 and gives a list of important points situated on railroads and the fuel-oil price per bbl. at these points. These prices range from $1.60 at Los Angeles to $2.80 at Needles and from $1.62 at San Francisco to $2.40 at Yreka. These figures represent the minimum and maximum prices in the southern and the northern sections of the state and are determined by the long and short haul freight rates. Though the commission's report compares these prices to former prices at 65c. to 80c. per bbl., it may be as well in this connection to call attention to the rise in price at the well in the several fields that became effective in May, 1918, ranging from $1.23 to $1.57 per bbl. for oil ranging in gravity from 14 to 37 deg. Bé. The cost of fuel oil to the consumer was increased in 1918, when the prices of materials essential to oil-well drilling increased and the materials could not be obtained even at exorbitant costs. If the price of oil at the well had not been increased to meet the high cost and threatened destruction of wells, there would have followed an industrial disaster that even ultimate greater costs to the consumer could not have forestalled. There would have been such a decrease in the petroleum production of the state that more industries would have been closed down for lack of fuel than were slightly hurt by the high costs. More than 2,000,000 bbl. of oil was consumed by the hydro-electric power and light companies because of the light rain and snow in the winter of 1917-1918. The gold-placer dredges were obliged to run on short time to conserve electric power to the essential uses required by the Government in the carrying out of war needs. The field stocks of oil were being steadily reduced by lack of drilling new wells and the increased demand for oil fuel. It does not seem reasonable that anyone could expect anything else than an increase in the cost of oil fuel. Possibly the cost to the consumer is just at this time, the close of the first quarter of 1919, higher than it should be. But the lowering of the cost to the consumer means a reduction in the price paid at the well to the producer, and it is doubtful if such a reduction as would benefit the consumer would insure a continued increase in production in the field.

BUTTE, MONT.—Apr. 12

Engineers' Union of Butte will consider a proposition refusing to allow any miner who is not a member of an organization affiliated with the A. F. of L. to be lowered into the mines, and a vote may be taken at the meeting on Apr. 13. This action is considered to be an effort to combat the local I. W. W. organization and Bolsheviki, who are seeking to undermine organized labor. This will be the first direct act of organized labor against these forces in the Butte district.

DENVER, COLO.—Apr. 15

Bureau of Mining and Commerce is the name of a new civic organization formed by mining men of Idaho Springs recently, for the purpose of promoting the mining and commercial interests of the City of Idaho Springs and the County of Clear Creek. The following officers have been elected to serve during the ensuing year: Charles Hancock, president; W. E. Pasmore, first vice-president; William Woodward, second vice-president; L. A. Hafer, secretary; and John Meyer, Jr., treasurer.

Mineral Experiment Station at Silverton, San Juan County, Colo., is the object of a resolution recently introduced in the State Senate by John H. Slattery, of Silverton. The resolution proposes that the Bureau of Mines, and the officials in charge of the experiment station at Golden, Colo., be requested to establish without undue delay, and to maintain at Silverton, for such period as may be deemed necessary, a field experiment station, for the study and investigation of and experimentation with problems connected with mining, milling, and reduction of ores, and the recovery of minerals and metals from the mines of the San Juan mining district. The State Bureau of Mines of Colorado is requested to cooperate with and assist the U. S. Bureau of Mines in the establishment of and the work to be done at such field station.

WALLACE, IDAHO—Apr. 14

Hecla Mining Co. held the annual meeting of the stockholders in Spokane, and the old officers and directors were reëlected. Two quarterly dividends of 15c. per share were authorized, payable June 28 and Sept. 28. After the meeting, James F. McCarthy, president, announced that the mine would continue in operation on the present basis of about 80% of normal production until the depression in the metal market is relieved. He also stated that the income and excess-profits tax for 1917 and 1918 is still unsettled and that A. W. Stranger, of Portland, will represent the company in the hearing before the Commissioner of Internal Revenue.

The Production of Gold in Shoshone County in 1918 was $302,360, according to the annual report of Robert N. Bell, State Mine Inspector, which gives this county the first place among the counties of Idaho. Prior to last year the production of gold had declined to a point of comparative unimportance, and this sudden advance is credited by Mr. Bell to the dredging operations of Yukon Gold Co. on Prichard Creek. Part of the gold produced in this county is credited to "byproduct gold derived from the final treatment of Coeur d'Alene lead ores." With the exception of one property which shipped considerable ore last year which carried $10 or more to the ton, the gold recovered from the lead ores of this district is almost negligible. There is a little gold in the ore, but it has been many years since it was sufficient to be reported on the smelter returns, and it is not now sufficient to pay the smelters to recover it from the slag. Thus it is evident that practically all of the gold produced last year in this county should be credited to the Yukon dredge. The manganese steel buckets are closely connected, have a capacity of 7 cu.ft. and dump at the rate of 20 per minute. D. H. Ferry is manager of the dredging operations.

SALT LAKE CITY, UTAH—Apr. 14

Potash-Producing Companies in Utah are interested in the National Potash Association, and delegates were sent to take part in the meeting of potash producers opened in Denver on Apr. 2, and held with a view to establishing such an association. Among others there were represented the Mineral Products Co., producing potash from alunite rock at Marysvale; the Ogden Portland Cement Co., producing from flue dust; and the Salt Lake Potash Co. Utah capital will be represented by the Liberty Potash Co., owning extensive deposits of leucite rock near Green River, Wyoming, from which it is planned to produce potash, according to a new process.

Important Legislation affecting the mining industry in Utah has been enacted by the State Legislature in the course of the session just ended. A "blue-sky" law has been passed; the workmen's compensation act passed two years ago has been amended; the taxation of metalliferous mines has been finally placed at "three times the net proceeds," with the Governor's signature—although himself strongly indorsing the insertion of the words "at not to exceed" three times the net proceeds—affixed Mar. 21. As has been previously mentioned in these columns, it was expected, after conference between the Governor, a committee representing the operators, and others, that, on payment of an occupation tax for the year just ended by mining companies contesting the constitutionality of this tax, the law as affecting taxation would be passed to stand at "not to exceed" three times the net proceeds. The Senate passed the bill as expected, but the House, under suspicion of certain members seeking political capital, failed to ratify it. In a communication to the Governor, the operators' committee, headed by Walter Fitch, of Eureka, formally released the Governor, after the House had failed to ratify the bill as passed by the Senate, from his obligation under agreement with it, without, however, endorsing the bill as passed. The new bill carries a section repealing the "occupation tax." The "blue-sky" law, becoming operative in May, 1919, presents certain features taken from the Michigan, Arizona, and California laws, including the "Pardee law," of California, almost entirely. The law requires all companies, dealers, and agents to file statements and obtain licenses from the state, the maximum filing fee for corporations being $25 annually. The fee for dealers or brokers is $10, and the statutory fees are required for copies of statements or other documents on file. Securities must be marked so as to show issuance under license of the state, the marking to recite this to be permissive and not to indicate indorsement by the state or recommendation of purchase. Publication in the state of the advertisement of unlicensed companies is prohibited, a provision being inserted to cover cases where foreign concerns without Utah agents place advertisements locally. Violation of the act is punishable by a fine of $1000 to $5000, and imprisonment in the state penitentiary for not more than five years. In regard to the Workmen's Compensation Law, a proposal seeking the establishment of monopolistic state insurance was defeated. The waiting period was reduced from 10 days to three days. Benefits were increased from 55 to 60% of the average weekly wage, and from $12 to $16 weekly maximum. Mine lessees are made employees of the mine for the purposes of the act, but the mine owner is permitted to deduct the amount of insurance from royalties paid under the lease. The provisions permitting mutual medical attention systems were retained in the law, although a strong effort was made to eliminate them. A bill was passed requiring a semi-monthly pay day and one prohibiting the collection of fees for obtaining employment. A basic 8-hour bill—the state already has a law fixing eight hours as a day's work underground—was defeated, as well as a "one day rest in seven" bill.

The date for the hearing of the suit between the Utah Consolidated and the Utah Apex Mining companies, of Bingham, in regard to the question of apex rights, has been set for June 2 by Judge Tillman D. Johnson of the U. S. District Court. The suit promises to be an interesting one both from a geological and legal point of view.

DULUTH, MINN.—Apr. 14

Navigation and the Iron-Ore Shipping Season opened here simultaneously upon the arrival of the steamer Pargny, of the Pittsburg Steamship Co., and the first train-

load of ore from the Mesabi Range. The recent bad weather did not delay shaft mines from shipping, and it is expected that open-pit loading will start soon. Shipment of ore from mines on the Vermilion Range was begun this week to the docks at Two Harbors, preparatory to loading the first boats, which will arrive Monday.

Ore-Royalty Tax Bill was passed by a vote of 92 to 25 in the Minnesota House of Representatives after the tonnage tax had been defeated. Practically all operating mines in Minnesota are worked on a royalty basis, and the ownership of the various properties is scattered among a large number of people—largely non-resident. Hence royalty incomes are considered in many quarters as unearned increment, and the sympathy which so largely aided the operator in his fight against the tonnage tax has been withheld from the fee owner. It is contended that the bill is a super-income tax, and hence illegal, and it is probable that, if the legislation should pass the Senate and the Governor, the courts will refuse to permit its operation, even though the state should thus lose the $525,000 annually which it is estimated would accrue.

HOUGHTON, MICH.—Apr. 10

Stocks of Copper in the United States today total approximately 1,600,000,000 lb. There are in Europe stocks of copper, owned by the governments of France and England and by large users of copper in those countries, totalling 650,000,000 lb. Together the total amount of unmarketed copper now for sale reaches more than two billion pounds.

Even with the restricted output of copper mines in the United States as operating since Jan. 1, the production was more than 300,000,000 lb. for the quarter. The total sales for that same quarter were 110,000,000 lb. So the total stocks of copper were added to, during the first quarter of 1919, by 190,000,000 lb., notwithstanding the fact that curtailment had been put into general practice wherever possible.

JOPLIN, MO.—Apr. 12

School of Mines in Oklahoma Section of the zinc and lead district has been assured. The Oklahoma Legislature agreed to appropriate $125,000 for a school to be situated at or near Miami, Okla., and Governor Robertson visited that town and announced that he favored getting the institution under way at the earliest possible date.

Community Prospect Drilling Campaigns are being planned in several of the older parts of the district where activity has recently fallen to a low ebb. Carl Junction, Mo., where there formerly were a number of good zinc producers, is the first place where a community company has actually placed a drill at work. It is planned to put the second drill in operation within a few weeks. Most of the leading business men and citizens of the town are interested in the effort to locate fresh ore deposits that will attract mining operators.

American Zinc Institute effected the creation of a local chapter at Picher, Okla. The latest meeting of the Tri-State Safety and Sanitation Association voted to merge the organization into that of the Institute. No change in officers or dues will be made, and the weekly luncheon meetings at Picher will be continued. The change was made without opposition and apparently met the full approval of all the mining men of the district. Stephen S. Tuthill, of New York, secretary of the American Zinc Institute, was a guest at the meeting, and, following the favorable vote to make the merger, declared that if there had ever been any question as to the success of the Institute it was now eliminated.

BIRMINGHAM, ALA.—Apr. 10

Woodward Iron Co.'s Shaft No. 4, being sunk by the E. J. Longyear Co., was incorrectly reported in regard to the monthly average rate of sinking in the Apr. 5 issue of the "Journal." The statement was made that sinking was being done at the average rate of 100 ft. per month, whereas information furnished by the E. J. Longyear Co. is to the effect that the shaft was started on Aug. 11, 1918, and up to Feb. 1 an average of 147 ft. per month had been maintained, and the average to Mar. 1 was 143 ft., the lower figure was owing to sinking through a particularly hard chert. After passing through this chert on Apr. 5, it is stated that expectations are to make 180 ft. for the month which was accomplished in January. The shaft is 13 x 21 ft., vertical, and is to be 1300 ft. deep. Fabricated steel sets are being put in, and it will be lined with concrete.

Tennessee Coal, Iron and Railroad Co. is considering building a giant aërial tramway or railway line from Red Mountain Top, near Ishkooda, to Fairfield and Ensley, to handle ore, which will result in considerable reduction of transportation expense. The estimated cost of this tramway is about $5,000,000, and the right of way is said to have been secured and complete details worked out for its construction. The Tennessee company has built, during the last year and a half, 1435 houses, a schoolhouse, an emergency hospital, and a large hospital costing $1,000,000, to be completed in a few weeks. This building record is in line with the industrial development policy of the corporation. There is still a scarcity of houses in the immediate vicinity of operations, and plans are said to be under consideration for more buildings. Other additions and projects of the company are given as follows: Manufacturing properties, work completed during the year—Ensley works: office building for roll shop and rail mill; additional openhearth furnace and converter; improvements to cooling system at blast furnace No. 2; turbo blower for converter department; 400-ton hot-metal mixer; equipment for separation of iron from slag; ladle-repair shop; pipe fitters and riggers' shop; chemical filtration system for feed water; bessemer furnaces, rebuilding Little Bell furnace; bessemer rolling mills, new office building; addition to drive on 8-in. guide mills. Work in progress: Ensley works-equipment at openhearth plant to facilitate triplexing process; additions to electric power-plant equipment, including 7500 kw. turbo generator; electric power-transmission lines; 10 high-duty drill presses for finishing mill. Fairfield works: a 45-in. blooming mill completed; also a 110-in. sheared plate mill and combination structural and bar mill; office and shop buildings, with complete equipment; facilities for finishing structural steel for ships. A bolt, nut, and rivet shop and two reheating furnaces are being installed.

Inquiries for Pig Iron in volume are coming in, but Birmingham producers assert that little business is being booked. A few car-lot sales were recorded during the week, and one of the cast-iron pipe plants took on a little tonnage; but the general business is still lagging, despite the reduction in iron prices recently. A large tonnage of iron is being sought for export, and Alabama interests could secure much of the business but for excessive freight across waters. Local operators hope to book part of the trade, and prominent iron interests state that if this business is obtainable the situation here will be relieved. Should there be a demand, approximately 180,000 tons is ready for immediate delivery, even though there has been some curtailment of production.

Manufacture of iron in Alabama for the month of March will be the lowest yet recorded, it is expected, furnace operations being kept up only where it is absolutely necessary. Little iron is being shipped now, consumers still holding off on receiving iron ordered last year and the first month of this year.

Owing to the Government policy of operating railroads as cheaply as possible, only where absolutely necessary are freight trains being run on Sunday, and as a result it is said that not a freight train was operated on Sunday, Mar. 30, on the Birmingham Mineral Division of the Louisville & Nashville R.R. The Birmingham Southern Ry., the railroad division of the Tennessee Coal, Iron and Railroad Company, had plenty of work to do, though the full force was not at work. The hot-pot trains between Alice furnace, in the city proper, and the steel plant of Ensley were running on schedule Sunday.

SPOKANE, WASH.—Apr. 10

United Copper Mining Company, which is operating in the Chewelah District, in an annual statement shows that, notwithstanding the high prices for labor and supplies in 1918, and the fact that operations were curtailed by a great shortage of electric power, there was an operating profit for the year of $48,674. Indebtedness on Jan. 1 amounted to $39,879, which has been practically wiped out since the date of the report by shipments of high-grade silver ore opened in the mine recently. It is believed that dividends will be resumed not later than June 15. President Wolfle states that from this date there should be a net profit of about $40,000 monthly.

VICTORIA, B. C.—Apr. 10

University of British Columbia has been voted $500,000 by the provincial government for use this year, contingent upon $250,000 being supplied by the dominion government.

Objection to Marketing Foreign Metals was taken at a recent meeting of the Trail, B. C., Reconstruction Board, and representations were made to the dominion government as indicated by the terms of the appended resolution:

"Whereas the whole interior of the Province of British Columbia is largely dependent upon the mining and smelting industry, and these industries are most seriously affected at the present time, owing to the demand for copper and lead being almost negligible; and

"Whereas such markets as may exist are flooded with metals dumped into Canada from other countries; and

"Whereas tremendous stocks of these metals exist in Canada at the present time, and, if relief is not quickly forthcoming, the entire industry will collapse and throw approximately 15,000 men out of employment; therefore be it

"Resolved by the Trail, B. C., Reconstruction Board on this 24th day of March, 1919, that the importation of these metals into Canada be allowed by special permit of the dominion government until the stocks of metals now on hand are disposed of and the money tied up in these stocks is released to carry on the industry again."

The Development of Magnetite Deposits of British Columbia is again the object of a third effort, this time to be made by William Sloan, Minister of Mines, who proposes asking the British Columbia Legislature, now in session, for authority to take from any of the iron ore properties of the province a quantity of ore not to exceed 10,000 tons in all for experimental uses. The owners, it is proposed, shall be allowed 25c. per ton, tax free, on ore taken. There are at present two small furnaces near Vancouver, B. C., owned by companies which are prepared to take advantage of the terms of such legislation. These are the Tudhope Electro Metals, Ltd., with office and factory at False Creek, and the Vancouver Magnetite Iron and Steel Smelting Co., Ltd., with a plant at Ronaldsay, Howe Sound, 27 miles from Vancouver. The Tudhope company, which has been treating scrap iron, has concluded, after conferring with Mr. Sloan, that to demonstrate satisfactorily the practicability of smelting British Columbia iron ores on a commercial basis, it might be necessary to operate a plant for an experimental period of six months, especially if various deposits were to be drawn upon for these experiments. As an inducement to undertake this, they asked of the provincial government 5000 tons of ore at the rate of about 1000 monthly. Mr. Sloan holds the opinion that there is available an ample supply of ore of the character necessary for producing the class of pig iron demanded by the British Columbia and foreign trade. It is likely, however, that the ore to be secured most readily is that to be found on claims more or less undeveloped, situated on or close to tidewater. The Tudhope company is ready to make necessary changes in its electric furnace for treating magnetite ores. The present equipment consists of a 25-ton 1500-kw. electric furnace recently completed at a cost of $50,000. The plant of the Vancouver Magnetite Iron and Steel Smelting Co. consists of a blast furnace having an estimated daily capacity of 25 tons of pig iron, which has been engaged in producing pig iron scrap. The management of the company is anxious to try smelting magnetite ores of British Columbia, and, with a supply for demonstration assured, is likewise prepared to make the necessary changes in its plant.

TORONTO, ONTARIO—Apr. 14

Dominion Government Has Appointed a Readjustment Commission, which will investigate the differences existing between labor and capital. The Canadian Mining Institute, representing, as it does, the second largest industry in the dominion, will ask for the appointment of one commissioner to represent this industry.

Deposit of Coal has been discovered as a result of intensive geological study of some of the formations along the Newfoundland railway. Engineers familiar with that country believe it to be the continuation of the Cape Breton coal measures. The coal, according to reports, is of good thickness and excellent quality.

Rock-Salt Deposit recently discovered at Malaga, in the Cape Breton district, Nova Scotia, is receiving attention from Ontario parties, and in all probability a serious attempt will soon be made to work it. The salt occurs in a flat-lying bed with an apparent thickness of 250 ft., and is found 85 ft. below the surface. A shaft has been sunk and has penetrated 50 ft. of salt of good quality. The fishing industry of the Maritime Provinces and Newfoundland absorbs about 100,000 tons annually, and practically all of this is imported from Great Britain and from Spain. This is the only known deposit of salt in Canada east of Lake Erie, and a good market for the product seems assured.

The Mining News

ALASKA

KENNECOTT (Kennecott)—Completion of a big tunnel between Mother Lode mine and Kennecott property disclosed high-grade deposit of ore similar to that in Mother Lode.

ARIZONA

Mohave County

HACKBERRY (Hackberry)—New mill, under construction nine months, has had trial runs, reported successful, with oil-flotation and table concentrates running, respectively, 360 and 240 oz. silver, in addition to 24% lead and some gold. Extraction said to be 85% of assay values. Plant has 200 tons' daily capacity. Fine crushing is by ball mills. Electric power for mill and mine is generated in three-unit oil plant. Start was witnessed by principal owners, Gus Holmes, of Salt Lake, and James Murray, of Butte. Ore, down to 900 level, blocked out for two years of mill consumption. Mine has been worked intermittently since discovery in 1874. William Neagle, manager.

NATIVE COPPER specimens brought into Kingman from large deposit lately found near Mud Springs, west of Chloride. John McCuish, Will Brakeman, and Jack Flynn have located 21 claims.

GOLD TRAILS (Kingman)—Two tons of ore shipped. Shaft will be sunk to 500 ft.

RICO EXPLORATION (Kingman) — Policy of deep exploration determined upon at late annual stockholders' meeting. New working shaft to be sunk.

McCRACKEN SILVER-LEAD (Signal) —Extended holdings by purchase of Otsega property on same lode. New mill to be in operation within few months.

Pima County

NEW CORNELIA (Ajo.)—Much of the mass of a 150-ft. hill has been blown up by a blast of 48,000 lb. of powder, that broke 200,000 tons of carbonate ore for handling by steam shovel. New strike in Ajo Consolidated ground developed unexpectedly rich ore, on 250 level, which had been missed in drilling explorations. Gross tonnage of developed ores above 1% now is estimated at 56,000,000, largely sulphide, to be handled in flotation plant projected. Sulphides shipped to Douglas, only carbonates and oxides being locally treated by leaching. Has cut off one shift; employing about 680 men.

CALIFORNIA

Amador County

ARGONAUT (Jackson)—Carbon dioxide is being used to fight fire which started in 4000 level. Work has been difficult and dangerous, some of the men have been gassed, but indications are that the fire soon will be smothered. Work resumed in upper levels.

KENNEDY (Jackson)—Work interrupted by gas from fire in Argonaut resumed Apr. 2. The two mines are connected by crosscut, which has been bulkheaded.

CENTRAL EUREKA (Sutter Creek)—To deepen shaft by contract 20 ft. to 3700-ft. point. Good ore on 3500 and 3600 levels, which are connected by winze.

Calaveras County

NELSON (Copperopolis) — Installing Cornish pump to clear large amount of water and permit development. Good ore disclosed.

Eldorado County

CHURCH-UNION (Nashville)—Preliminary survey and examination by Albert Burch, of San Francisco, representing Bewick, Moreing & Co.

Inyo County

PINE CREEK TUNGSTEN (Bishop)—To resume extraction and treatment of ore when weather permits.

WILSHIRE (Bishop)—Remodeling milling plant. To resume operation soon.

Kern County

WINNIE (Randsburg)—Optioned by Los Angeles men for $20,000. Development to begin immediately. Charles Koehn is owner.

Nevada County

BENTON G. (Nevada City)—Repairing and retimbering completed; main tunnel being advanced toward channel.

IDAHO-MARYLAND (Grass Valley)—Deed conveying Gold Point Consolidated to this company filed with county recorder, bearing $2900 revenue stamps. This is part of the recent consolidation by Erroll MacBoyle and the Bulkeley Wells interests.

Plumas County

ARCADIAN (Greenville)—To start active development in May. Mine worked intermittently in past. Optioned by Charles A. Joy.

NEW YORK (Greenville)—Crosscut tunnel advancing toward main ledge under lease to D. W. Shanks and associates, of San Francisco.

Riverside County

PALISADE (Blythe)—To ship carload of silver-lead ore. New road one mile long from mine, completed at cost of $3000, essential to motor-truck haul to railroad. Ore runs from $50 to $127 a ton. Hansen, Villman, and Yost are principal owners.

Siskiyou County

FIFTY CHROME MINERS assembled at Yreka, formed an association and arranged to send delegates to the next meeting of the Pacific Coast Chrome Association at San Francisco. The Siskiyou County association was formed by electing H. J. Barton, chairman; J. P. McNamara, secretary, and R. H. Lake, treasurer. Delegates selected are Gus Reichman, George Milne, and W. A. Murray.

COLORADO

Boulder County

SMUGGLER (Balarat) — At directors' meeting decided to build a cyanide plant. E. E. Warren appointed mine superintendent, Melvin Brugger retained as consulting engineer, and G. R. Prunty appointed purchasing agent. Recent development work opened high-grade gold ore.

BLUEHILL (Jamestown)—Operating old Standish Law mine. Opened 12-in. vein of silver-lead ore. C. H. Hunt, manager.

MELVINA (Salina) — Trial shipment made to Boulder Ore Sampling Co. James F. Bartlett, manager.

VICTORIA (Summerville) — Opened a lead-silver orebody carrying gold. Winze being sunk from 400 level east heading.

BIG FOUR (Leadville)—Local operators secured lease and started development. Electric hoist and other equipment installed.

BOHN (Leadville) — Development resumed by Peter Horrigan and associates; opened a blanket vein carrying silver.

DERRY RANCH GOLD DREDGING (Leadville)—Plan to resume dredging operations during April. Crew has been employed in repairing dredge; 10 men now removing ice from dredging pond. Ice formed to depth of 4 ft., being broken up by dynamite, and cakes hoisted to shore by wire-rope cableway. R. F. Lafferty, general manager.

Teller County

MODOC (Cripple Creek)—Opened commercial ore on 1000 and 1200 levels of Last Dollar shaft and during March shipped 350 tons.

LONGFELLOW (Victor)—Being developed and operated by the Excelsior Mining, Leasing and Electric Co. under lease from Stratton Cripple Creek Mining and Development Co. Orebody opened between fifth and sixth levels of Llewellyn shaft. Winze being sunk on vein 10 ft. wide. During March, five carloads shipped from this winze.

IDAHO

Shoshone County

OLD HICKORY (Mullan)—Work suspended in tunnel where lead-silver ore was disclosed for 400 ft., ranging in width from a few inches to 3 ft. Appears to be top of oreshoot. Preparing to drive crosscut 2500 or 3000 ft. to cut ore 500 ft. deeper. Compressor will be ordered, as now using Star plant.

HECLA (Wallace)—Company paid quarterly dividend of 15c. per share on Mar. 28, amounting to $150,000. Total amount paid by company to date, $7,405,000. Annual meeting will be held in Spokane on Apr. 8.

INTERSTATE-CALLAHAN (Wallace)—Annual meeting of company will be held at Phoenix, Ariz., on Apr. 14. Four directors will be elected. Action will also be taken on proposal to move main office of company from New York to Wallace.

KANSAS

Joplin District

VINEGAR HILL (Baxter, Kan.) — Placed electric shovel in its Barr mine, the first to be tried in the district. J. G. Trewartha is general superintendent.

MICHIGAN

Copper District

CALUMET & HECLA (Calumet)—Copper production for March as follows: Ahmeek, 1,930,333 lb.; Allouez, 455,664; C and H, 4,592,295; Centennial, 149,423; Isle Royale, 1,093,660; La Salle, 13,800; Osceola, 1,038,204; Superior, 83,314; White Pine, 295,360 pounds.

MINNESOTA

Cuyuna Range

WAGES have been reduced at practically all mines to the basis which prevailed through 1918 up to August and September of that year.

ARKO (Ironton)—Shipping manganiferous ore to Zenith Furnace Co., Duluth.

MINNESOTA MANGANESE (Ironton)—Has taken option from the Shawmut Co., of Duluth, on SE¼ of the NW¼ and the SW¼ of the NE¼ of Section 9-46-29. Will have property drilled under contract by Osterberg & Johnson.

ONEIDA MINES (Ironton)—Readjustment of affairs in progress, to allow its Clark and Sultana mines, recently shut down, to be reopened.

ONAHMAN IRON (Trommald)—Ferro and Algoma mines closed down Mar. 29.

Mesabi Range

MILLER (Aurora)—Small cave-in Mar. 31, resulted in one death.

LAURA (Hibbing)—First Mesabi-Range property to start loading for Lake shipment. Beginning Apr. 1 about 15 cars daily over Great Northern.

WEBB (Hibbing)—Work on new crushing and screening plant temporarily suspended.

BENNETT (Keewatin)—Preparing for complete electrical equipment. Power from Great Northern Power Co., which is now installing transformers for stepping current down to 250 v. Concrete foundations for electric pumps in south side of underground workings being laid.

Vermilion Range

SECTION THIRTY MINE (Ely)—Resumed shipments to Zenith Furnace Co., West Duluth; about two hundred tons daily.

MISSOURI

Joplin District

FREEHOLD O. & G. (Joplin)—Started second mill at Waco; will start construction of No. 3 plant immediately. No. 1 property situated just across state line in Kansas; other two in Missouri. No. 2 plant at start indicates unusually rich recovery from dirt obtained at 172 ft. W. S. Marquiss, Webb City, Mo., is manager.

MONTANA

Jefferson County

HOPE AND KATIE (Basin)—Fifty-ton carload to Washoe works at Anaconda. Value, $15,000 gold.

EVENING STAR (Boulder)—Two carloads silver-lead ore from 70-ft. shaft.

ROBERT EMMETT (Boulder)—Two shifts driving tunnel to lead below old shaft. Silver-lead ore.

AMALGAMATED SILVER, (Clancy)—Crew of 27 men working on Free Coinage, and contractors driving 200-ft. drift on Muskeegan. Both mines in ore.

FREE COINAGE (Clancy)—Second carload in March to smeltery from Free Coinage vein. Net returns from smelter on ore shipped before was 129 oz. silver.

LEGAL TENDER (Clancy)—Small shipment to smeltery. High-grade silver ore. Shaft 500 ft. deep.

MONEY MINE (Clancy)—Drifting at 150-ft. level. Six to 8 in. high-grade silver ore.

MONTANA

Lewis and Clark County

HELENA MINE (Helena)—Eighteen inches steel galena in south 400 level.

NEW YORK MONTANA TESTING AND ENGINEERING (Helena)—Have contract with Carnegie Steel Co. for manganese ore and concentrates calling for 500 tons per month, expiring Aug. 1, 1919. Filling contract with concentrates from ore shipped by Clark-Montana Realty Co., at Butte. Crude ore averages 32% Mn and 40% SiO_2, and by jigs and Wilfley tables concentrated to 49 to 51% Mn and 10-12% SiO_2. Ratio of concentration is about 2.4 to 1. Engineering staff of this company will have charge of equipping and operating Monarch Mining and Power Co.'s property situated 14 miles south of Elliston. There are being installed a 125-hp. steam plant, a 12-drill compressor, and sawmill. A two-mile tramway and a 200-ton concentrator will be erected this summer. Ore is silver-lead, carrying some gold and copper. Chas. E. Fryberger, manager.

STEMWINDER (Helena)—Carload silver ore to smeltery netted $1300.

WHITLATCH (Unionville) — Repairing 500-ft. shaft to mine gold ore.

Silver Bow County

DAVIS DALY (Butte)—Board of directors arrived in Butte on Apr. 9 for an inspection of mines. Expect board to decide to begin operations at Mount Moriah shaft, a former silver producer adjoining Anaconda property on Butte Hill.

NEVADA

Nye County

TONOPAH DISTRICT ore production for week ended Mar. 29 was 7074 tons, of estimated gross milling value of $120,258. Producers were: Tonopah Belmont, 2337 tons; Tonopah Mining, 1050; Tonopah Extension, 1873; West End, 946; Montana, 128; Tonopah Divide, 245; Jim Butler, 173; MacNamara, 210; Cash Boy, 9; and the Halifax 103 tons.

GOLDFIELD DEVELOPMENT CO. (Goldfield)—A. I. D'Arcy, general manager, discussed Combination mine being operated by company in recent report to effect that, if cheap mining was done upon tonnage and grade of ore present, profitable operation would result. Expect to drive haulageways on level below 380 level throughout ore channel from January shaft to Florence line, and by system of raises and chutes ore will be brought to surface. Cannot use Combination shaft, because it is partially in vein, and surface ground would cave in drawing off ore. Will use 600-ft. shaft 300 ft. from vein sunk in early days, requiring only retimbering. Cost of drifts, raises, chutes, stations, and repairs to adopt this method estimated less than $60,000. Property equipped now with hoists, compressors and underground electric haulage locomotives. Expect to handle 500 to 1000 tons daily. Will use cyanide process at mill, which requires $15,000 for repairs and changes.

NEW JERSEY

Morris County

WHARTON STEEL CO., Wharton, near Dover, N. J., has acquired the Black Rock Mining Co.'s property and rights situated near Dover and Morristown. About 400 employees went on strike Apr. 2, demanding 50c. per hour and an eight-hour day.

NEW MEXICO

Grant County

BOSTON-HECLA (Lordsburg) — Have started sinking main shaft, which will be collared as three compartment and then reduced to two compartment. Timber headframe will be erected at once. Jim Jackson, superintendent of 85 Mine, has contract for first 40 ft. at $22.50 per ft. including everything but raw timber; will be hand work. Remainder of contract, 260 ft., not yet closed; accepting bids. R. E. Van Druff, president.

85 MINE (Lordsburg)—Being examined by A. S. & R. representative under direction of Julius Kruttschnitt, southwestern manager. Working 200 men in mine, and shipping 300 tons ore daily. Mill shut down and force discharged.

GREAT EAGLE SPAR MINE (Lordsburg)—Shut down; has 3500 tons high-grade calcium-fluoride ore in bins and 300 tons on railroad loading platform; will resume with better market. Fred. Kroll, superintendent.

JO HITCHINS (Lordsburg)—Working lease on surface ores on Superior claim of 85 Mine.

LAST CHANCE (Lordsburg)—Building adobe-concrete storage and watchman's house on ore platform of A. & N. M. Ry.; 22 tons concentrates shipped during month, valued at about $25,000; 15 ft. of ore on 220 ft. level. B. Prescott, superintendent.

OCTO (Lordsburg)—Temporary shutdown of shaft sinking while bulkheading water seams on 140 level; changing tanks and piping, and, when completed, shaft sinking will be resumed. E. Ernest, superintendent.

OKLAHOMA

Joplin District

LONG-HUNT (Hockerville)—Purchased N. J. B. mill, at Duenweg, Mo., and will move it to lease southeast of Hockerville. W. P. Longmire, Sapulpa, is president; T. R. Dean, Miami, secretary, treasurer, and manager.

ALAMO L. & Z. (Miami)—Has taken over Lucky Bob, situated northwest of Quapaw, Okla., and begun operations; has been down for six months.

RED ROSE (Quapaw)—Operating mill with dirt trammed from First National, half mile distant.

TEXAS

Brazoria County

CROWN (West Columbia) — Building fourth storage tank to furnish capacity of 1,000,000 gal. To handle output, will put in either pipe line or build barges to operate on Brazos River. Recently brought in 5000-bbl. well on No. 1 Marmion tract.

HUMBLE OIL (West Columbia)—Two steel tanks of 55,000-bbl. capacity each being built. Contracts for others may be let. Recently 6000-bbl. well brought in on No. 2 Girard tract.

Eastland County

FIRE AT RANGER on night of Apr. 6 destroyed several square blocks of business district. Loss in buildings estimated about $100,000, most of buildings being roughly constructed, as Ranger was boom town; but loss of contents estimated from $500,000 to $750,000. Rebuilding will probably begin at once. Oil field not damaged.

Liberty County

AMERICAN PETROLEUM, as subsidiary of the Republican Production Co., will build pipe line from Hull field to Victor, where it will connect with company's pipe line running from Humble to refinery of Petroleum Refining Co. on Huston ship channel.

Matagorda County

TEXAS GULF SULPHUR (Gulf) — Amendment to charter filed increasing capitalization from $3,000,000 to $5,000,000. Now producing over 1000 tons sulphur per day. Third well being steamed. First shipments being made.

Wichita County

TEXAS PETROLEUM REFINERS' ASSOCIATION (Wichita Falls)—Formed Apr. 5 by refiners of this section. Object is readjustment of freight rates to Northern and Eastern consuming territories. Ardmore rates are present basis; differential over Tulsa rates wanted.

UTAH

Juab County

CHIEF CONSOLIDATED (Eureka)—Quarterly dividend this time 6¼c. a share, usual amount 12½c., payable May 1. Amounts to $55,265, bringing total by company to $1,400,795. Paid $379,900 during 1918. March shipments, 103 cars or about 5000 tons. February, 100 cars, and January, 96.

IRON KING (Eureka)—Shipments of fluxing iron ore to be started on completion of Goshen Valley R.R. to this property and Tintic Standard.

PLUTUS (Eureka)—Understood soluble limestone expected at 50 ft. below 1000 level not encountered at this distance, and sinking of winze to be continued.

Salt Lake County

MICHIGAN-UTAH (Alta) — Aerial tramway to Tanners Flat in process of repair. Damaged by snowslide. Expected to be ready for operation in about a week.

LITTLE COTTONWOOD TRANSPORTATION (Alta)—Narrow-gage road operating between Wasatch and Tanners Flat. It is expected that tracks to Alta will be clear in three or four weeks. Will be capable of handling about 300 tons of ore daily, with new Shay engine added, bringing number to three engines.

OHIO COPPER (Bingham)—Local creditors in conference with secretary of company in regard to indebtedness. Company also owes about $125,000 in East, due on improvements to mill and added flotation department, which cost was about $550,000. Mill fire of last year also a setback. Assets and controlling interest in Mascotte tunnel and railway estimated by secretary to exceed $2,000,000 in value. Issue of mortgage to cover debts and furnish operating fund under consideration. Operations suspended recently, owing to drop in metal prices.

UTAH-SALDURO (Salduro) — Company has filed papers showing capitalization of $2,000,000 to take over and operate potash and salt works of Solvay Process company at Salduro, producing potash and salt from brines underlying Great Salt Lake desert or salt beds, near Wendover, on the Western Pacific Railroad.

WASHINGTON

Ferry County

LONE PINE-SURPRISE CONSOLIDATED (Republic) — Will resume shipments of ore from Last Chance mine. Plan to ship 50 tons a day to Tacoma smeltery. Shaft down 690 ft. below collar. Excavation being made for 100-ton ore pocket, just below 650 level, where vein is entered. Employing 16 men.

Stevens County

OLOLIM COPPER (Spokane)—Producing ore from property in Spokane Indian reservation. Ore coming from drift on vein at 100-ft. depth; reported shaft will be sunk 210 feet.

CANADA

British Columbia

LOUIS CREEK MINING (Louis Creek) —Has installed machinery for recovery of gold.

KITSELAS MOUNTAIN MINING (Usk) —Situated on the Grand Trunk Pacific Ry. negotiating for sale to North Dakota syndicate, which recently made examination.

Manitoba

FORBES CLAIMS (The Pas)—These eight claims near Mile 194, Hudson Bay Ry., purchased by North Canada Exploration Co. some time ago. Shaft was put down 75 ft., encountering reported high-grade ore. Machinery of Sultana mine at Kenora, Ontario, also owned by company, being shipped to property.

Ontario

LA ROSE (Cobalt)—Has given up its option on Homestake mine in Kamloops district, British Columbia.

TEMISKAMING (Cobalt)—Still negotiating for purchase of Dolly Varden and Wolf properties, Portland Canal district, British Columbia. Difficulty still experienced in getting railway situation cleared up.

WHITE RESERVE (Elk Lake)—Contracted for drifting and crosscutting at 140-ft. level. Number of veins opened up on surface.

WRIGHT HARGREAVES (Kirkland Lake)—Has decided to increase mill capacity from 150 to 200 tons a day. Construction work will start soon.

DOME (Porcupine)—Expects to start milling on Apr. 15. Work now under way on Dome Extension, which is under option.

HOLLINGER (Porcupine) — Treating 2500 tons a day and producing about $7,000,000 a year.

MEXICO

Baja California

CAMPAGNIE DU BOLEO (Santa Rosalia)—February production of copper was 1,803,645 pounds.

BRAZIL

DIAMOND MINES at Moribeca and Boa Vista in the region of Diamantina, according to report of Vice-Consul Richard P. Momsen at Rio de Janeiro, will be developed by a company recently formed under the name of Companhia Brazileira Diamantifere. Practically all of the capital of the organization is represented by properties belonging to the Syndicato Diamantino.

SPAIN

POTASH BEDS of Catalonia, according to report of Consul General C. B. Hurst, at Barcelona, may be worked under concessions being granted to foreign and Spanish companies. Concessions have been awarded to Solvay & Co.; Minas de Suria, Santander, Spain; Sociedad Anonima Fodina, Lauria 21, Barcelona, and the Sociedad Anonima La Sevillana, Trafalgar 11, Barcelona, Spain.

The Market Report

SILVER AND STERLING EXCHANGE

Apr.	Sterling Exchange	Silver New York, Cents	Silver London, Pence	Apr.	Sterling Exchange	Silver New York, Cents	Silver London, Pence
10	4.6500	101⅛	48⅛	14	4.6600	101⅛	48⅛
11	4.6450	101⅛	48⅛	15	4.6550	101⅛	48⅛
12	4.6500	101⅛	48⅛	16	4.65 5	101⅛	48⅛

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

DAILY PRICES OF METALS IN NEW YORK

Apr.	Copper Electrolytic	Tin Spot.	Lead N. Y.	Lead St. L.	Zinc St. L.
10	15 0 @15.30	†72½	4.95 @5.00	4.65 @4.70	6.15 @6.20
11	15. 0 @15. 5	†72½	4.95 @5.00	4.65 @4.70	6.12½ @6.17½
12	15. 0 @15. 5	†72½	4.95 @5.00	4.65 @4.70	6.12½ @6.17½
14	15. 0 @15. 5	†72½	4.90 @5.00	4.65 @4.70	6.05 @6.10
15	15.10 @15.15	†72½	4.90 @5.00	4.65 @4.70	6.02½ @6.07½
16	15.10 @15.15	†72½	4.90 @5.00	4.65 @4.70	6.00

† Government price.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for the deliveries constituting the major markets, reduced to basis of New York, cash, except where St. Louis is the normal basing point.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other special shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for spelter are for ordinary Prime Western brands. We quote New York price at 35c. per 100 lb. above St. Louis.

LONDON

Apr.	Copper Standard Spot	Copper Standard 3 M.	Copper Electrolytic	Tin Spot	Tin 3 M.	Lead Spot	Lead 3 M.	Zinc Spot
10	77⅛	77⅛	81⅛	227	225	25	24	36½
11	76⅝	76⅝	81	225½	223¾	24½	24	36½
12								
14	76⅛	76⅛	81	222½	219	24½	24	36½
15	77⅛	77⅛	81	223	219½	24½	24	35½
16	76⅛	76⅛	81	224	221½	24½	24	35½

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb.

Metal Markets

NEW YORK—Apr. 16, 1919

All of the principal metal markets exhibited a declining tendency this week. Business was very dull. Both lead and zinc fell to about the low points of the year.

Transatlantic freight is quoted at 1c. per lb., but shipping arrangements are not easy to negotiate.

The stocks of metals held by the British government on Apr. 1, with the corresponding figures for Mar. 1 stated in brackets, were as follows, in short tons: Copper, 54,546 (57,537); lead, 108,030 (112,070); zinc, 42,612 (40,660); aluminum, 24,886 (14,564); nickel, 2675 (2612); antimony, 4884 (4844). The reductions in copper and lead were the first reductions in any month since the armistice, and probably indicate the feeding out of those metals into consumption and the gradual cessation in arrivals.

According to the London Metal Exchange, the stocks of copper in public warehouses, exclusive of those in the hands of the government, were 5387 long tons on Mar. 1, compared with 2596 tons on Feb. 1.

German papers report that the stocks of copper and brass in that country prove to be larger than was supposed, and the producers of spelter who were expecting to dispose of their metal as a substitute are disappointed. Spelter production has been maintained at a high rate, and stocks have accumulated uncomfortably; wherefore German producers are contemplating selling for export in neutral countries.

Copper, Tin, Lead and Zinc

Copper—The quotation of 15½c., delivered, regular terms, is maintained as something to talk about, but copper sold right along for less money, 15⅜c. having been accepted during the early part of the week, while during the latter part business was done on the basis of 15¼c., delivered, regular terms. Aside from one special transaction, the volume of business was all but insignificant, the market being distressing in its dullness.

There were reports of a good deal of copper being offered by brokers, who obtained their supplies from speculative hands and from consumers, some of whom overbought last month and desired to resell.

Copper Sheets—The base price of copper sheets is 22½c. per lb. Copper wire is quoted at 17@17½c. per lb. f.o.b. mill, carload lots.

Tin—There are no new features to report. The U. S. Steel Products Co. is understood still to have a good deal of tin to sell.

Lead—The reduction in the price last week failed to stimulate any large buying, and nothing but ordinary business has been done at the reduced price. Indeed, some interests that have desired to sell lead have cut the price further without being able to market much. The Government is selling its lead, and although the total that it desires to sell is not very large, nevertheless, a little goes a long way in a market that is so thin as this one is at present. The St. Louis market was scarcely more than nominal throughout the week.

The War Department on Apr. 12 issued the following statement:

"Disposition of the surplus stocks of lead owned by the War Department is being made at current market prices in the community in which the surplus is held. This surplus is scattered throughout the country and in no one place is there a large quantity. Reports from the several bureaus show a total amount of 7000 tons of lead to be in possession of the War Department. This surplus lead is not being placed on the market in quantity at any one time, but is being sold in small quantities in various places."

Zinc—The sharp decline in this metal was apparently started by some speculative selling, but some of the smaller smelters immediately tried to force sales, with the result of sharp declines from day to day. On Apr. 15 a carload was reported sold at 5.97½c., and on Apr. 16 a round lot was done at 6c. The aggregate business for the week was not very large.

Labor troubles in Oklahoma appear to have been composed temporarily, and the several plants are now in operation except Sand Springs, which was closed in anticipation of a strike. Among the other plants there is a general curtailment of production.

High-grade spelter is quoted at 6¾c.

Japan has recently been offering spelter in England.

Zinc Sheets—The quoted price of zinc sheets is $11 per 100 pounds.

Other Metals

Aluminum—Prices quoted range from 29@31c. Unchanged.

Antimony—Nothing but small business was done. Offerings reflected a softer tone. We quote spot at 6¼@6¾c. April-May shipments were offered as low as 6¼c. However, the supplies now on the way from the Orient are believed to be small.

Bismuth—Metal of the highest purity for pharmaceutical use is quoted at $3.20 per lb. for wholesale lots—500 lb. and over.

Cadmium—Quoted at $1.40 per lb. in lots of 500 pounds.

Nickel—Ingot, 40c.; shot, 43c.; electrolytic, 45c. per pound.

Quicksilver—This metal was firmer, and we quote $72½@75. There is said to be not much in stock in New York, but some shipments are on the way.

Silver and Platinum

Silver—The London quotations have fluctuated between 48⅛ and 48⅜d., dependent on sterling exchange, but New York price has remained fixed at $1.01⅛ under Government control. On and after May 1st next, depositors in the U. S. Assay office will have the option of receiving proceeds of silver deposits in fine silver bars or selling same to the Government at a price to be fixed by the Director of the Mint. Recently the Government has declined to return proceeds of deposits in fine silver and has purchased same at $1.00 per ounce 1000 fine. Exports last week from New York to London amounted to 506,145 ounces.

Mexican dollars at New York: Apr. 10, 77½; Apr. 11, 77½; Apr. 12, 77½; Apr. 14, 77½; Apr. 15, 77½; Apr. 16, 77½.

Platinum—Stronger. We quote $100.

Palladium—We quote $115@120.

Zinc and Lead Ore Markets

Joplin, Mo., Apr. 12—Blende, per ton, high, $42.85; basis 60% zinc, premium, $40; Prime Western, $40@38; sludge, $36; flotation, $33; calamine, basis 40% zinc, $26@25. Average selling prices: Blende, $39.68; calamine, $27.22; all zinc ores, $39.22.

Lead, high, $63.85; basis 80% lead, $62@60; average selling price, all grades of lead, $61.62 per ton.

Shipments the week: Blende, 10,866; calamine, 418; lead, 1801 tons. Value, all ores the week, $553,540.

Further labor difficulties are expected at the smelteries on the 15th, when workmen at other smelteries than those closed down are expected to go out on a wage strike. Reports are current that a strike of coal miners is probable on Apr. 16.

Platteville, Wis., Apr. 12—Blende, basis 60% zinc, $42.50 base for premium grade and $40 base for high-lead blende. Lead ore, basis 80% lead, $56 to $58 per ton.

Shipments reported for the week are 2014 tons blende, 230 tons galena, and 255 tons sulphur ore. For the year to date the totals are 28,312 tons blende, 1412 tons galena, and 702 tons sulphur ore. For the week 2544 tons blende was shipped to separating plants.

Other Ores

Manganese Ore—High-grade furnace ore was mentioned as low as 40c. per unit.

Molybdenum Ore—No business reported.

Tungsten Ore—Charles Hardy reports as follows: "Not only sentiment but actual business in tungsten has undergone considerable improvement during the past week, and we know of business in tungsten ore, ferrotungsten, and tungsten powder at a scale which compares very favorably with the business done since the signing of the armistice. During the week ended Apr. 8, the highest price paid for ordinary tungsten ore that we could report was $6 per unit. During the past week business has actually been done in Chinese ore for spot delivery at $7 per unit. High-grade scheelite is offered at $10 per unit, at which price also a smaller quantity of the highest grade wolframite can be obtained. Tungsten metal was sold at $1.50 per lb. during the week.

Other Minerals

Pyrites—Spanish pyrites is quoted at 17c. on the basis of 10s. ocean freight. Unchanged.

Iron Trade Review

PITTSBURGH—Apr. 15

There is virtually an open market in pig iron, but prices are not quotable below the nominal level, because there has been no business to bring out cut prices. In steel products, predictions of an open market are less plentiful. Less criticism is heard in the pig-iron and steel trades than in the daily newspapers of Director General Hines' refusal to accept the Industrial Board steel prices as a basis for the making of railroad purchases. What the steel trade chiefly regrets is the practical disappearance of the promised opportunity to control prices by agreement, through the industry holding meetings and having the Industrial Board approve the prices decided upon. However, the recent operation accomplished one thing, enabling the steel trade to make another reduction in prices, the first having been made in December, without throwing the market open to competition. Business will now probably drift until developments arise. The common opinion among steel producers is that little additional business would be brought out by making further price reductions, though a certain amount of business must be placed from day to day, no matter what prices have to be paid.

So far as concerns actual purchases of steel, the so-called Peek-Hines controversy is of relatively small import, for at best the amount of buying the Railroad Administration would be in position to do is limited. At present about 500,000 tons of rails are due the railroads, with shipments going forward at about 40,000 tons a week, so that no large rail tonnage would be required in the near future, and, as to cars and locomotives, many already in existence are idle. A comprehensive program of railroad buying awaits not simply the development of prices satisfactory to the railroads, but also the enactment of legislation by Congress defining the status the railroads are to occupy when the properties are returned to their owners, everyone being convinced that they will be returned some time.

The steel industry is now operating at about 70% of capacity, chiefly on small orders that are drifting in day by day, for immediate shipment, and specifications on contracts. Steel-ingot production in March was at the rate of about 37,900,000 tons per year, or about 77% of capacity, estimating capacity at 49,000,000 tons. If the mills are operating at 70% of capacity, they are producing steel at about 10% more than the average rate in the best years—1912 and 1913—prior to the war. Nevertheless the steel business is everywhere regarded as being extremely dull.

Pig-Iron—No business has been done in the past week worth mentioning. A leading merchant furnace interest states that an inquiry for 1000 tons would be sufficient to bring out a cut price. Meanwhile the market is quotable nominal at the old figures, as reduced first $3 and then $4.25 from the Government prices, as follows: Bessemer, $27.95; basic, $25.75; foundry, $26.75; forge, $25.75, f.o.b. Valley furnaces, with $1.40 freight to Pittsburgh. Merchant furnaces are going out of blast every week, and the furnaces are practically a unit in preferring to see prices take their natural course, forcing furnaces out of blast and thereby operating to reduce production costs, until a balance is struck at which profitable business can be done.

Steel—An inquiry for 100 tons of forging billets is referred to as the first indication of demand for a long time for such material and as representing more activity than has lately been encountered in any description of unfinished steel. Specifications on billet and sheet-bar contracts are rather light, and are only to cover orders for finished steel already booked. Regular prices, practically nominal, are: Billets, $38.50; sheet bars and small billets, $42; slabs, $41; rods, $52.

Ferroalloys

Ferromanganese—Reports have it that resale 80% ferromanganese can be had at $115, delivered, against $130 formerly quotable. Furnaces continue to hold to $150. Resale spiegeleisen is about $42, shipping point. There is practically no demand for either manganese alloy.

Coke

Coke—Coke production in the Connellsville region continues to decrease, and even some of the byproduct ovens are running rather slack. Odd lots of Connellsville furnace coke on track and requiring to be moved to save demurrage charges have been offered at down to $3.60. The regular settling price for April deliveries on contracts seems to be $4.25. Foundry coke commands $4.50 to $6, according to brand, per net ton at ovens.

MONTHLY AVERAGE PRICES OF METALS

Silver	New York			London		
	1917	1918	1919	1917	1918	1919
Jan.	75.630	88.702	101.125	36.682	44.356	48.438
Feb.	77.585	85.716	101.125	37.742	42.792	48.027
Mar.	73.861	88.082	101.125	36.410	43.620	48.171
April	73.875	95.346	.....	36.963	47.215	.....
May	74.745	99.505	.....	37.940	48.980	.....
June	76.971	99.500	.....	39.065	48.875	.....
July	79.010	99.625	.....	40.110	48.813	.....
Aug.	85.407	100.292	.....	43.418	49.077	.....
Sept.	100.740	101.125	.....	50.920	49.500	.....
Oct.	87.332	101.125	.....	44.324	49.500	.....
Nov.	85.891	101.125	.....	43.584	48.969	.....
Dec.	85.960	101.125	.....	43.052	48.492	.....
Year	81.417	96.772	.....	40.851	47.516	.....

New York quotations cents per ounce troy, 999 fine; London, pence per ounce, sterling silver, 925 fine.

Copper	New York		London			
	Electrolytic		Standard		Electrolytic	
	1918	1919	1918	1919	1918	1919
Jan.	23.500	(a)	110.000	92.238	125.000	106.619
Feb.	23.500	16.763	110.000	78.700	125.000	95.700
Mar.	23.500	14.856	110.000	76.821	125.000	82.071
April	23.500	.....	110.000	.....	125.000	.....
May	23.500	.....	110.000	.....	125.000	.....
June	23.500	.....	110.000	.....	125.000	.....
July	25.904	.....	119.913	.....	134.913	.....
Aug.	26.000	.....	122.000	.....	137.000	.....
Sept.	26.000	.....	122.000	.....	137.000	.....
Oct.	26.000	.....	122.000	.....	137.000	.....
Nov.	26.000	.....	122.000	.....	137.000	.....
Dec.	(a)	.....	118.447	.....	133.167	.....
Year	24.628	.....	115.530	.....	130.507	.....

(a) No Market.

Tin	New York		London	
	1918	1919	1918	1919
January	85.500	67.702	293.227	248.557
February	92.000	66.801	311.525	223.963
March	(a)	67.934	318.875	236.843
April	(a)	.....	329.905	.....
May	(a)	.....	364.217	.....
June	(a)	.....	331.925	.....
July	(a)	.....	360.347	.....
August	(a)	.....	380.900	.....
September	(a)	.....	343.905	.....
October	(a)	.....	335.543	.....
November	(a)	.....	323.550	.....
December	(a)	.....	267.736	.....
Av. year	(a)	.....	330.138	.....

(a) No average computed.

Lead	New York		St. Louis		London	
	1918	1919	1918	1919	1918	1919
January	6.782	5.432	6.684	5.316	29.00	37.227
February	6.973	5.057	6.899	4.784	29.00	28.675
March	7.201	5.226	7.091	4.992	29.00	27.952
April	6.772	.....	6.701	.....	29.00	.....
May	6.818	.....	6.704	.....	29.00	.....
June	7.611	.....	7.511	.....	29.00	.....
July	8.033	.....	7.750	.....	29.00	.....
August	8.050	.....	7.750	.....	29.00	.....
September	8.050	.....	7.750	.....	29.00	.....
October	8.050	.....	7.750	.....	29.00	.....
November	8.050	.....	7.750	.....	31.20	.....
December	6.564	.....	6.324	.....	30.00	.....
Year	7.413	.....	7.222	.....	30.10	.....

Spelter	New York		St. Louis		London	
	1918	1919	1918	1919	1918	1919
January	7.836	7.272	7.661	6.922	54.000	56.045
February	7.814	6.623	7.639	6.273	54.000	46.150
March	7.461	6.500	7.286	6.150	54.000	38.500
April	6.890	.....	6.715	.....	54.000	.....
May	7.314	.....	7.114	.....	54.000	.....
June	8.021	.....	7.791	.....	54.000	.....
July	8.688	.....	8.338	.....	54.000	.....
August	8.985	.....	8.635	.....	54.000	.....
September	9.442	.....	9.092	.....	54.000	.....
October	8.801	.....	8.451	.....	54.000	.....
November	8.491	.....	8.141	.....	54.100	.....
December	8.163	.....	7.813	.....	56.050	.....
Year	8.159	.....	7.890	.....	54.180	.....

New York and St. Louis quotations, cents per pound London, pounds sterling per long ton.

Pig Iron Pgh.	Bessemer‡		Basic‡		No. 2 Foundry	
	1918	1919	1918	1919	1918	1919
January	$37.25	$33.60	$33.95	$31.40	$33.95	$32.40
February	37.25	33.60	33.95	31.40	33.95	32.40
March	37.25	32.54	33.95	31.40	33.95	29.12
April	36.15	.....	32.95	.....	33.95	.....
May	36.20	.....	33.00	.....	34.00	.....
June	36.36	.....	33.16	.....	34.16	.....
July	36.60	.....	33.40	.....	34.40	.....
August	36.60	.....	33.40	.....	34.40	.....
September	36.60	.....	33.40	.....	34.40	.....
October	36.60	.....	34.40	.....	35.40	.....
November	36.60	.....	34.40	.....	35.40	.....
December	36.60	.....	34.40	.....	35.40	.....
Year	$36.67	.....	$33.70	.....	$34.45	.....

‡ As reported by W. P. Snyder & Co.

STOCK QUOTATIONS

N. Y. EXCH.†	Apr. 15
Alaska Gold M.	3⅛
Alaska Juneau	2½
Am.Sm.&Ref.,com.	71⅛
Am.Sm. & Ref., pf.	105
Am.Sm.Sec., pf., A	92½
Am. Zinc	14
Am. Zinc, pf.	43½
Anaconda	62⅜
Batopilas Min.	1⅛
Bethlehem Steel	76
Butte & Superior	22½
Butte Cop. & Zinc	7⅛
Cerro de Pasco	42½
Chile Cop.	23⅜
Chino	37
Colo. Fuel & Iron	42
Crucible Steel	68½
Crucible Steel, pf.	93½
Dome Mines	14½
Federal M. & S.	10
Federal M. & S., pf.	38
Great Nor., ore ctf.	41⅛
Greene Cananea	41⅞
Gulf States Steel	51⅛
Homestake	98
Inspiration Con.	49⅛
International Nickel	26⅛
Kennecott	32⅜
Lackawanna Steel	70
Mexican Petrol.	188⅛
Miami Copper	23⅜
Nat'l Lead, com.	71¼
National Lead, pf.	108
Nev. Consol.	16⅞
Ontario Min.	7
Ray Con.	21
Republic I.&S., com.	83⅛
Republic I.&S., pf.	102
Sloss-Sheffield	53
Tennessee C. & C.	14
U. S. Steel, com.	99⅜
U. S. Steel, pf.	116⅞
Utah Copper	75⅛
Va. Iron C. & C.	54
Worthington Pump	71½

BOSTON CURB*	Apr. 15
Alaska Mines Corp.	‡.12
Boston Ely	1⅛
Boston & Mont.	.63
Butte & Lon'n Dev.	.11
Calaveras	1
Chief Con.	3⅛
Contact	.05
Corbin	‡.25
Cortez	.12
Crown Reserve	.35
Crystal Cop.	.32
Eagle & Blue Bell	2⅛
First Nat. Cop.	1⅛
Houghton Copper	.20
Intermountain	‡.05
Iron Blossom	.40
Iron Cap	.11
Majestic	.09
Mexican Metals	.18
Mines of America	‡.05
Mojave Tungsten	.05
Nat. Zinc & Lead	.13
Nevada-Douglas	.12
New Baltic	1
Oneco	.20
Pacific Mines	‡.25
Rex Cons.	.13
Yukon Gold	.17

SAN FRAN.*	Apr. 15
Alta	.02
Andes	.25
Best & Belcher	.14
Caledonia	.10
Challenge Con.	‡.03
Confidence	‡.03
Con. Virginia	1.30
Gould & Curry	.07
Hale & Norcross	.17
Jacket-Cr. Pt.	.06
Mexican	.49
Occidental	‡.40
Ophir	1.15
Overman	.04
Savage	.25
Sierra Nevada	.27
Union Con.	.55
Utah Con.	.03
Belmont	3.00
Jim Butler	.38
MacNamara	.70
Midway	.58
Mont.-Tonopah	.20
North Star	.08
Rescue Eula	.11
West End Con.	1.75
Atlanta	.05
Booth	.30
Comb. Frac.	‡.03
Florence	.35
Jumbo Extension	.13
Kawanas	.05
Nevada Hills	.03
Nevada Packard	.20
Round Mountain	.38
Silver Pick	.09
White Caps	.20

COLO. SPRINGS*	Apr. 15
Cresson Con.	5.00
Doctor Jack Pot	.04½
Elkton Con.	.05½
El Paso	.15
Gold Sovereign	‡.02
Golden Cycle	1.85
Granite	.15
Isabella	.05½
Mary McKinney	.06
Portland	.93
United Gold M.	.19½
Vindicator	.38

BOSTON EXCH.†	Apr. 15
Adventure	‡.75
Ahmeek	73
Algomah	‡.30
Alloues	36½
Ariz. Com.	11⅛
Arnold	‡.20
Bingham Mines	38½
Bonanza	‡.10
Butte-Balaklava	‡.30
Calumet & Ariz.	60
Calumet & Hecla	405
Centennial	12½
Copper Range	43⅛
Daly West	2⅞
Davis-Daly	5⅛
East Butte	8⅛
Franklin	3⅞
Granby	‡70
Hancock	6
Hedley	‡12
Helvetia	‡.25
Indiana	‡.50
Isle Royale	26
Keweenaw	‡1⅛
Lake	4⅛
La Salle	2⅞
Mason Valley	‡2⅛
Mass	4⅛
Mayflower	4
Michigan	3⅜
Mohawk	57⅛
New Arcadian	1⅜
New Cornelia	17⅛
New Idria	‡9⅛
North Butte	11⅛
North Lake	.45
Oilbway	‡1⅛
Old Dominion	33⅛
Osceola	49
Quincy	56
St. Mary's M. L.	‡40
Santa Fe	‡.25
Seneca	14
Shannon	2
Shattuck-Ariz.	‡14⅛
So. Lake	.75
So. Utah	‡.12
Superior	5
Superior & Bost.	2⅛
Trinity	2⅛
Tuolumne	‡.75
U. S. Smelting	49
U. S. Smelting, pf.	47⅛
Utah Apex	2
Utah Con.	8
Utah Metal	‡2
Victoria	2
Winona	‡.80
Wolverine	17⅛

N. Y. CURB†	Apr. 15
Big Ledge	⅛
Butte & N. Y.	‡⅛
Butte Detroit	.04
Caledonia	.36
Calumet & Jerome	⅛
Can. Cop. Corpn.	1⅛
Carlisle	‡2
Cashboy	.11
Con. Ariz. Sm.	1⅛
Con. Coppermines	‡5
Goldfield Con.	.18
Goldfield Merger	.05½
Greenmonster	‡⅛
Hecla Min.	5⅝
Howe Sound	‡3
Jerome Verde	‡⅛
Louisiana	⅛
Magma	‡31
Marsh	.06
McKinley-Dar-Sa.	.46
Milford	‡.75
Mother Lode	.42
Nixon Nevada	.28
Ohio Cop.	.50
Rawley	‡2½
Ray Hercules	2
Richmond	‡.55
Rochester Mines	.21
St. Joseph Lead	11
Standard S. L.	⅛
Stewart	.23
Success	.04½
Tonopah	‡3½
Tonopah Divide	10
Tonopah Ex.	2⅛
Tribullion	‡.25
Troy Arizona	‡.10
United Eastern	4½
United Verde Ext.	‡32½
United Zinc	‡⅛
Utica Mines	‡.08

TORONTO*	Apr. 15
Adanac	.17
Bailey	.04
Beaver Con.	.43
Chambers Ferland	‡.10
Coniagas	2.00
Hargraves	.02
Kerr Lake	5.00
La Rose	.25
Lake Shore	.93
Min. Corp. of Can.	2.00
Nipissing	‡8.75
Peterson Lake	.07
Temiskaming	.32
Wettlaufer-Lor.	.04
Davidson	.68
Dome Exten.	.27
Dome Lake	.24
Hollinger	6.12½
McIntyre	1.37
Newray	.12½
Pocu. Crown	.26
Teck-Hughes	.26
Vipond	.20
West Dome	.13

* Bid prices. † Closing prices. ‡ Last quotations.